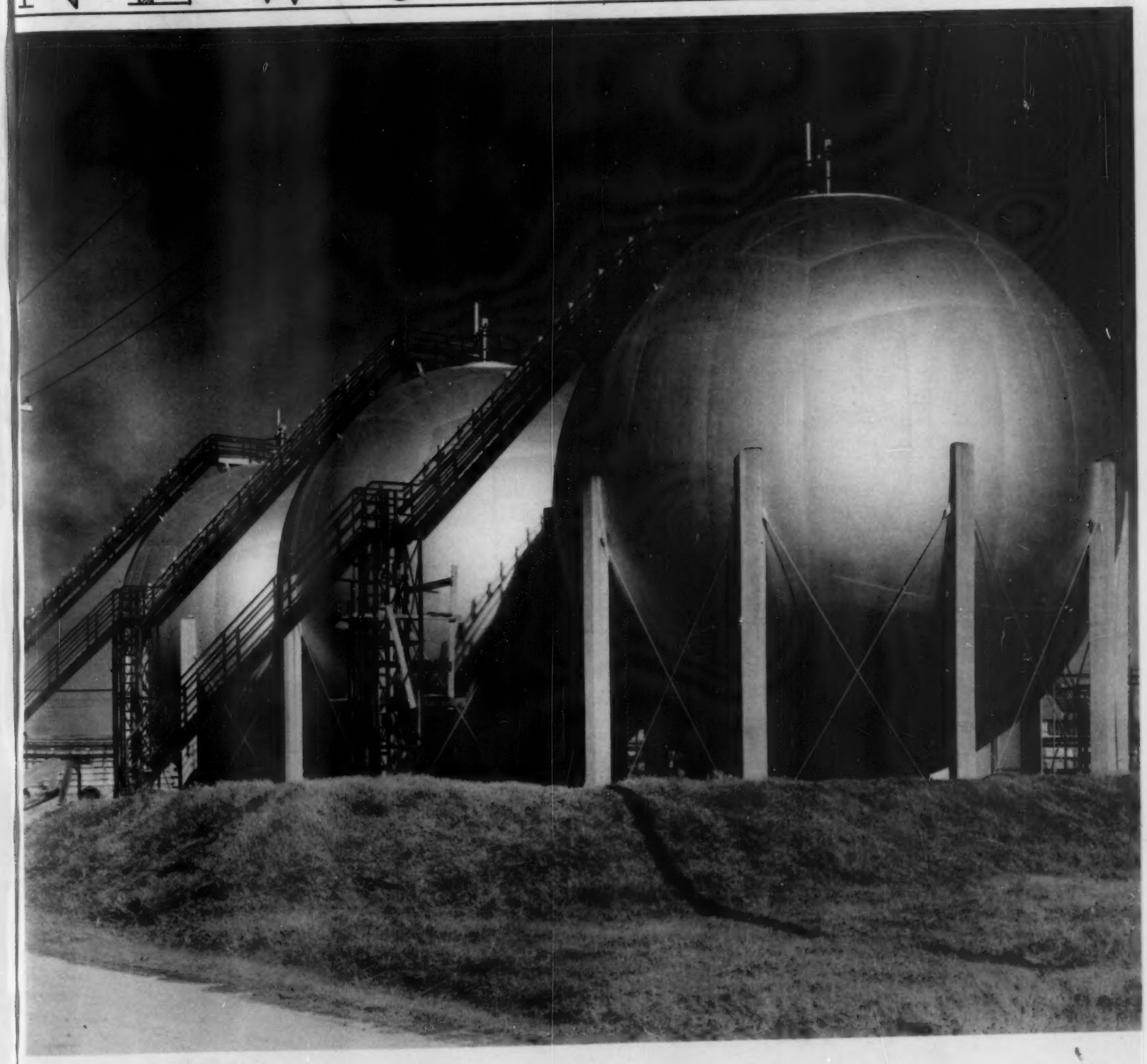
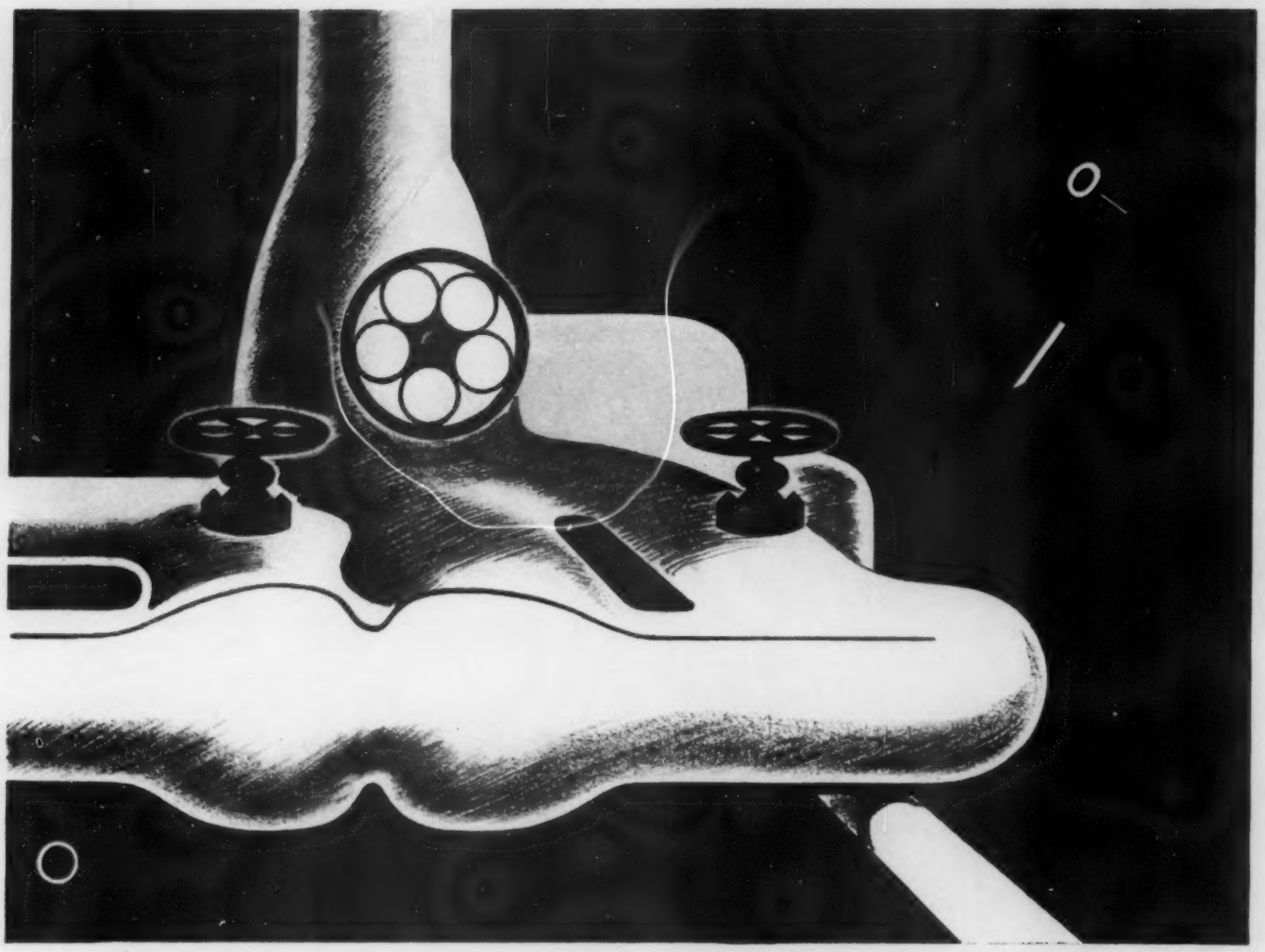
TECH ENGINEERING NEWS



MARCH · 1939



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MOLY

George Bradshaw, '40

OUR AUTHORS

W. D. BEARCE is the very capable writer of the article entitled "Fare, Please" in this issue of THE TECH ENGINEERING NEWS. His service as Department Statistician of the Transportation Engineering Department at the Erie plant of General Electric Company and previous experience have qualified him particularly for editing this article. After entering the employment of the above mentioned company in 1906, Mr. Bearce enjoyed activity in the Testing Department, followed by time spent as technical writer in the Publicity Department from 1910 to 1913. The two years between 1908 and 1910 took him away to the post of instructor in electrical engineering at the University of Pennsylvania. Mr. Bearce enjoyed his college days at the University of Maine, where he received his B.S. degree in Electrical Engineering in 1906, followed by a post-graduate degree of Electrical Engineering in 1912. Besides being a prominent lecturer on the subject of transportation, he has written the book "Heavy Railway Electrification."

JOHN T. RULE, author of this month's article on three-dimensional photography, graduated from the Institute in 1921, a member of Course XV, and after a year of graduate work at Harvard he spent two years with the Scullin Steel Company. In St. Louis he was a consulting industrial engineer until 1930. Two years of this time he was in charge of a Curtiss Wright factory in that city. He began to teach in 1930, and it was then that he became interested in three-dimensional photography in connection with a solid geometry course which he taught. He joined the Institute staff in the fall of 1936 and has done extensive work in the field of stereoscopic photography since that time. Today he is a professor in the Drawing Department and a member of the Graduate Scholarship Committee.

CHARLES A. SPEAS, '42, who writes this month's article on cigarettes, is a graduate of the R. J. Reynolds High School of Winston-Salem, N. C. He is a student in the Mechanical Engineering Course at the Institute and is on the Editorial Staff of THE TECH ENGINEERING NEWS.

JERRY COE, '42, author of the biographical sketch of Dugald C. Jackson, is a native of Madison, Wis., where he graduated from West High School. After graduating from Phillips Exeter Academy, he decided to enter Course X at the Institute.

The biography in this issue is based on interviews with Professor Jackson himself and with Dean Moreland, Professor Jackson's engineering partner for many years.

In addition to working for THE TECH ENGINEERING NEWS Coe is on the Race Committee of the Nautical Association, sails on the Freshman sailing team, and is a member of the Freshman Council.

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This one helps entertain and instruct millions

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C O N T E N T S

OUR COVER THIS MONTH

The three "Hortonspheres" shown on the cover and the "Hortonspheroids" at the left are of welded construction erected by the Chicago Bridge and Iron Company, and form part of the storage facilities of a Gulf Coast refinery. The spheres, with a capacity of 12,500 barrels each, are designed to operate at 50 pounds per square inch pressure while the spheroids have an operating pressure of 15 pounds per square inch.

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AND NEXT MONTH

Brings a feature article on "Coal Distribution in New England," supported by "The Manufacture of Abrasives" and Uses for Cellophane and Related Products." The interesting results of the experiment with the Blind Fold Cigarette Test given on the sales day of the March issue will also be included in the April issue.

THE TECH ENGINEERING NEWS

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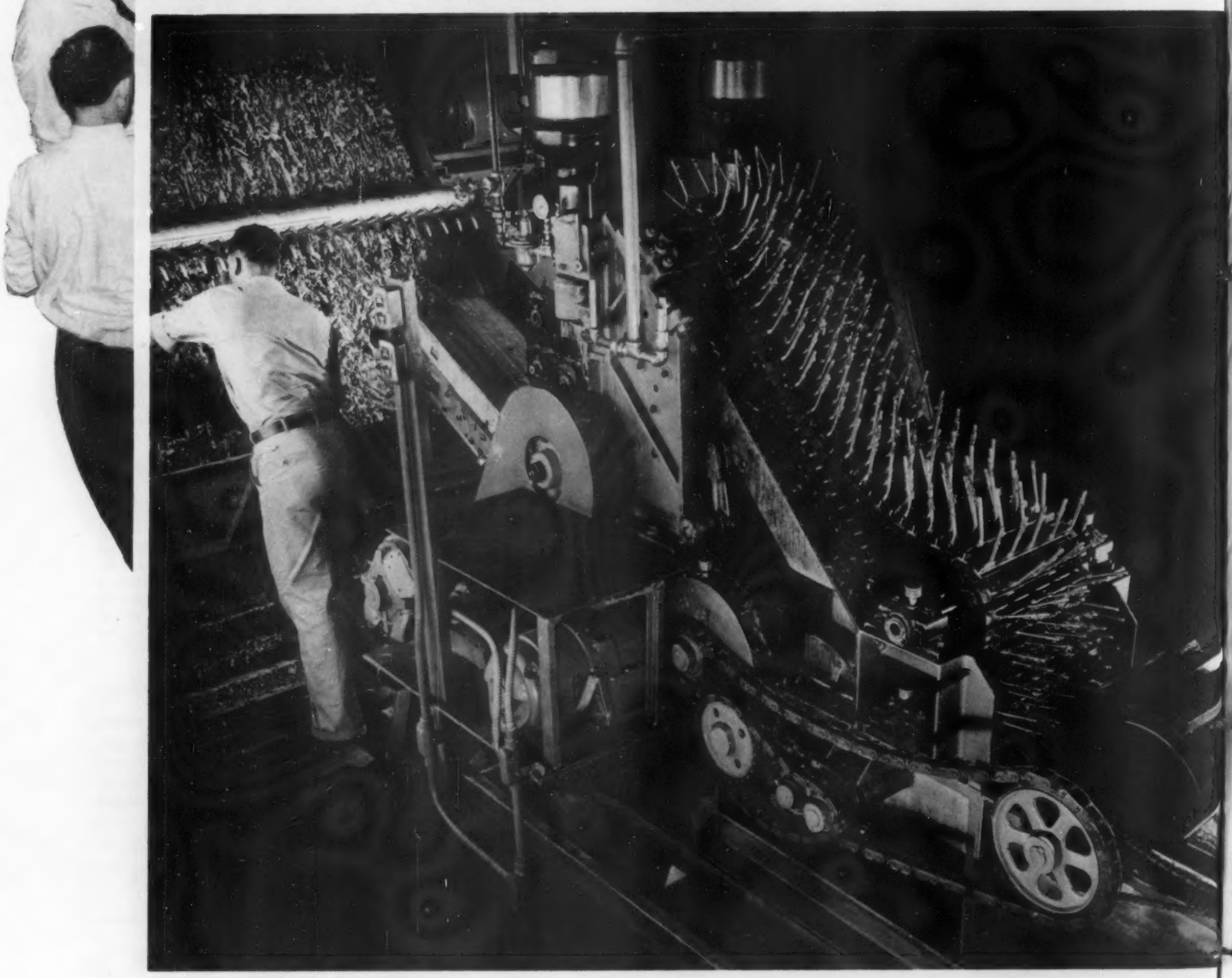
Tobacco auction in warehouse at Winston-Salem, where sixty million pounds of leaves are sold annually. Below is a view of an automatic wringer and spreader for drying machine.

Winston-Salem Chamber of Commerce



Holmes I. Mettes

Mellos

Packs of Twenty

HUGE INDUSTRY INSPIRES AMERICA'S NUMBER ONE HABIT TO THE EXTENT OF FIVE THOUSAND CIGARETTES LIT PER SECOND

CHARLES A. SPEAS, '42

TODAY the cigarette industry is one of America's strongest. Since 1926 the "Big Four," the leaders in the never ceasing race for supremacy in the field, have backed expensive advertising — one company alone having spent an average of $11,000,000 a year during the past five years for publicity. Until seven years ago this particular concern had followed the conservative advertising principles established by the founder of the company. Then it reluctantly injected millions of dollars into an elaborate advertising program, and, as a result, the business is one of the strongest of the "Big Four," which proves again the advantage of expensive advertising.

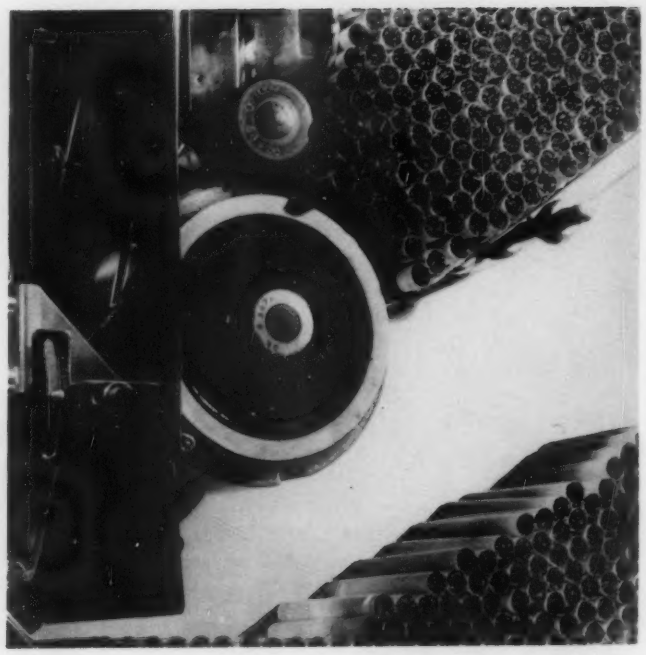
This growth in trade, which is typical of all of the larger concerns, has meant prosperity to the manufacturer, satisfaction to the laborer, an increase in the stockholder's dividends, and a corresponding increment in the government revenue payments. One of the larger concerns pays enough in Federal revenue every day to build two new post offices for some good sized city. These statements are not surprising when one considers the fact that an average of *over five thousand American-made cigarettes are lit every second.*

Although not quite so large and powerful a business as it is today, the tobacco industry was one to be contended with as far back as before the War. It was then that the Government found it necessary to take steps toward dissolution of a trust which was an outgrowth of the success of one of the larger concerns. This concern had its beginning innocently enough as did the other major tobacco companies. In 1858 in a leading North Carolina town the firm of Morris & Wright began the manufacture and sale of their "Best Flavored Spanish Smoking Tobacco." This tobacco was only an ordinary average new product until their first advertising campaign, which proved to be one of the cheapest and yet most successful ever staged. Federal soldiers raided the small plant toward the close of the Civil War and carried generous samples back to the North. So impressed were they with the quality of the tobacco that they soon began to send orders back to the town after their return home.

This introduction, along with the idea of wrapping the tobacco in strips of white paper, caused the industry to flourish. Meanwhile a few other similar enterprises had sprung up in other parts of the State, and their rapid growth seemed to prove that America had found a new, dignified pleasure and pastime.

Fortune

Spraying the tobacco with the flavoring compound



Fortune

The cigarettes await packing

The actual production of the cigarette begins after the tobacco has passed from farmer to buyer through the medium of the tobacco auction, which features the unintelligible utterances of the much publicized auctioneer. After sale, upon arrival at the plant, the tobacco is placed upon conveyers which haul it slowly into a huge oven known as a redrying unit. It may be well to point out here that the leaf is itself the taskmaster of all that it undergoes, since the slightest defect which might develop during this and other processes might ruin the tobacco. The unit mentioned above is kept at a temperature of 200 degrees, and every particle of atmospheric moisture is removed.

With some companies this procedure is being supplanted experimentally by a newer method known as the thermo-vacuum process. While still in the hogshead the tobacco is rolled into a huge container in which a vacuum is set up. A steam thermo compresser removes the vaporized moisture from the plant, and in this way the amount of waste tobacco caused by handling can be eliminated. The thermo-vacuum process also enables the redrying of green leaves while still in the hogshead by use of high frequency waves, which set up surface currents in plates on either side of the container. The resulting heat from these plates proves sufficient to remove the moisture.

After leaving this part of its development into the cigarette, the tobacco moves into a compartment known as the cooling chamber, in which fresh air and carefully regulated humidifiers impart just the right amount of moisture to the leaf, and after leaving this initial step, it is packed and stored for about three years. While in storage tobacco undergoes the natural chemical reaction of fermentation.

Upon removal from the warehouse the leaves are "stemmed." Not many years back the process was done almost entirely by hand, but recently, with the government requirements for minimum hours and higher wages for the employee, the manufacturer has found it to his advantage to perfect machines for this purpose.

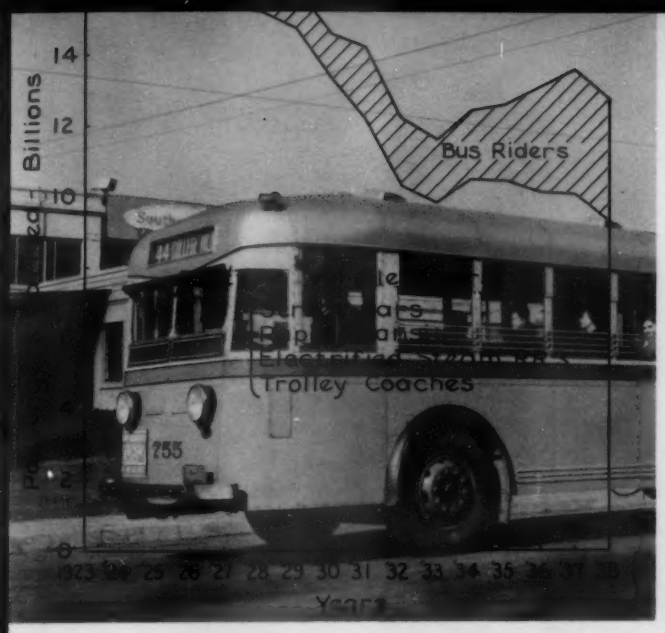
The machinery used exemplifies the ingenuity of today's engineer and designer. It unties the bundle of leaves, strips the leaf up from the end of the stem, and then removes the stem from the remainder of the leaf. The part removed comprises about 25 per cent of the leaf and is the source of one of the main by-products of the industry, nicotine sulphate, which is itself used as an animal and plant insecticide.

The tobacco now undergoes processes which vary with the different companies. One concern subjects its product to the "toasting" process, which differs from other treatments in three ways mainly: higher heat treatment, "bulking," and the use of ultraviolet rays. The heat treatment is similar to that used by other cigarette manufacturers except that it is higher by many degrees. The "bulking" is merely a piling up of the leaf for a day or so, which supposedly blends the different types of tobacco which comprise the mass. After this second stage the tobacco proceeds to the shredding machines where it is cut to slender ribbons. These machines are capable of cutting 1,700 pounds an hour. It is then bathed in ultraviolet rays and is consequently "irradiated." The product then receives an eight-day rest before it is made into the cigarette.

Although other companies have different treatments for their tobacco, the blend is usually about the same in each case. One typical blend is 55 per cent Turkish (itself a combination of five), and five per cent fast burning Maryland. Since it is deficient in sugar, the Burley is dipped into a syrupy mixture of licorice, brown sugar, and various herbs. The other tobaccos are sprayed with a mixture of honey and maple sugar and a hygroscopic agent. The difference in tobaccos lies largely in the type of flavoring the particular brands receive and the type of hygroscopic agent used. After the tobacco is cut into shreds it receives another spray whose base is usually some sort of rum, but which also may contain essences of chocolate, vanilla, tanka, coumarin, sherry, peach, orange,geranium, and angelica. Strangely enough, the flavors are not detectable in the smoke but rather make for a pleasant aroma upon opening the package.

The hygroscopic agent is usually an important part of the processing. The purpose of its use in the blend is to give the cigarette tobacco the power to attract and retain moisture, and, in most cigarettes, this agent is glycerine. One concern uses a more complex member of

(*Please turn to page 43*)



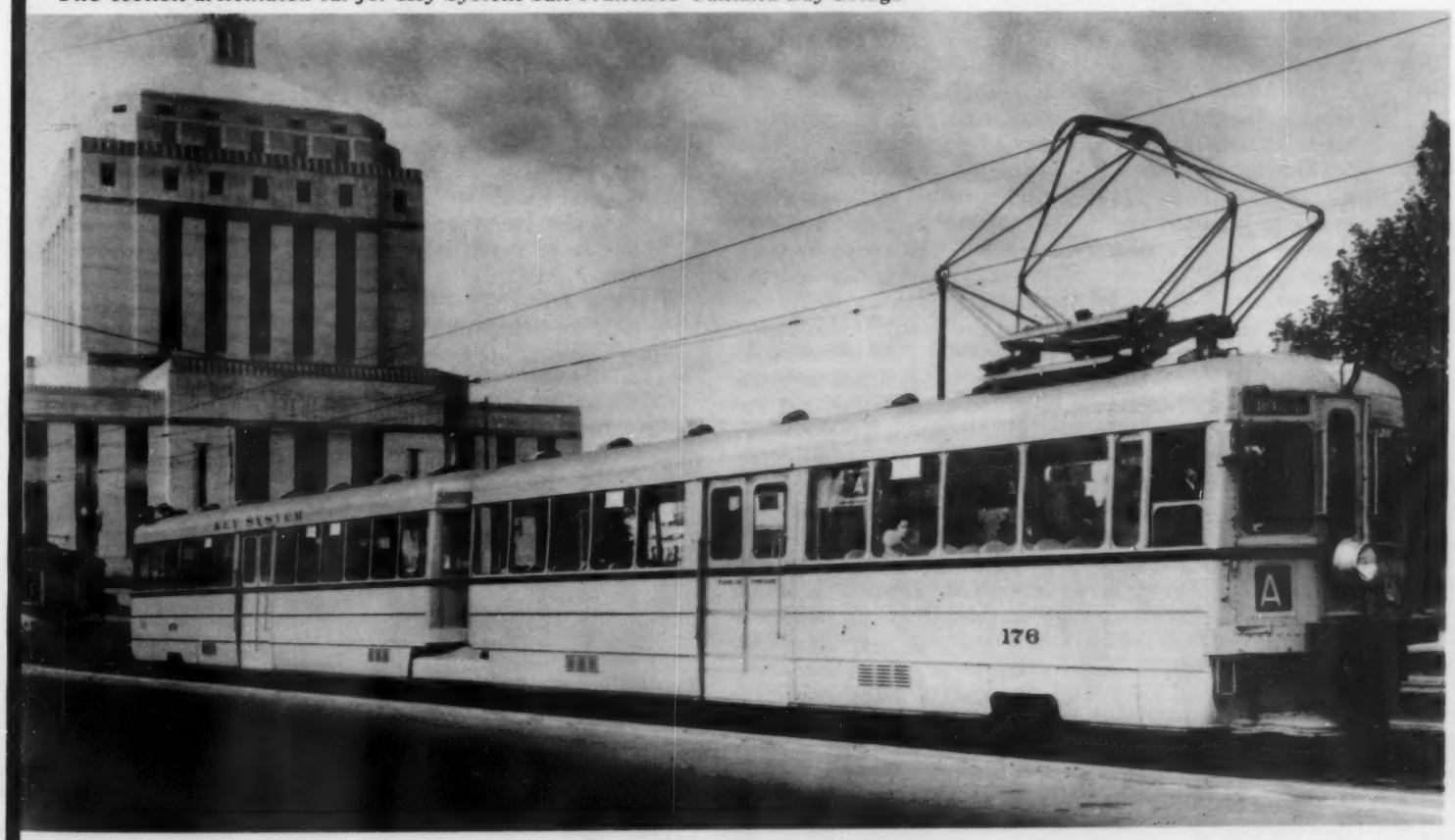
➤Fare, Please➤

W. D. BEARCE
Transportation Engineering Department of the General Electric Company

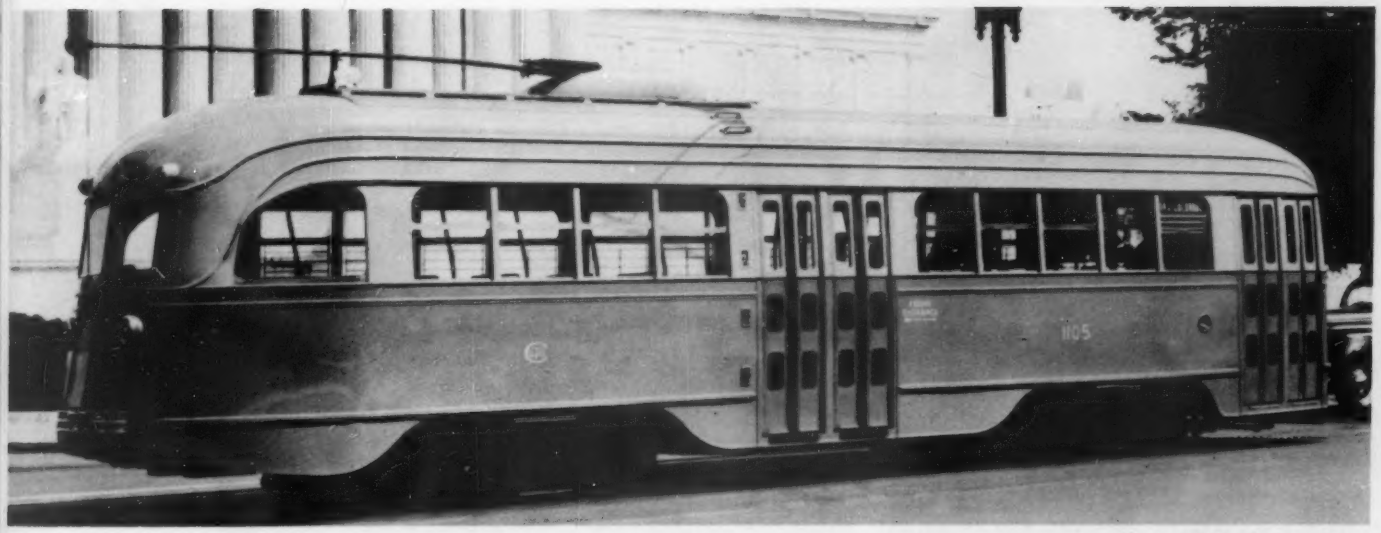
● THE ELECTRIC TROLLEY NOW OPERATES SWIFTLY AND SILENTLY WITH OR WITHOUT RAILS

DURING the year 1938 the electric railways and other public transportation systems in the United States carried a total of more than 12½ billion passengers. This figure includes 128½ million passengers handled by electrified suburban steam railroads. It is significant that nearly eight billion passengers were reported from cities of over 500,000 population. As indicated by the accompanying chart, the traffic handled by the city transportation systems and in smaller communities has shown a gradual decrease for a number of years. While there is no question that a portion of this decrease may be attributed to the increasing use of private automobiles, it is nevertheless significant that the reduction in transit riding from the 1927 level is about 18 per cent, or practically the same as the decrease in employment in manufacturing industries. In other words, the business of transportation suffers with other business during periods of low industrial activity and improves in a like manner when business picks up. It is safe to assume, therefore, that the total number of passengers handled by the several types of city transportation will increase as business returns to normal. As will be observed from the chart, the number of passengers transported during

Two-section articulated car for Key System San Francisco-Oakland Bay Bridge



General Electric Co



New Presidents' Conference Committee trolley car in service in Washington, D. C.

General Electric Co.

1938 by the several electric transportation systems approximates 73 per cent, and those carried in motor buses made up the remaining 27 per cent.

An analysis of current figures on transportation in cities and in smaller communities shows a very definite trend over a period of years toward the increased use of buses in smaller communities. In communities under 25,000, for example, approximately 75 per cent of the riders are transported in motor buses. In cities of over 500,000, however, street cars, rapid transit, trolley coaches and suburban electrified lines account for more than 84 per cent of the riders.

The density of the traffic is the prime factor in the determination of the proper type of transportation equipment for any community. Rapid transit lines, that is to say subway and elevated systems, are economically possible only in the larger communities. There are none of importance anywhere in the United States in cities of under one-half million population. It is also a fact that electrified steam railroads are operating extensive suburban service only in communities above this size.

During the past few years outstanding improvements have been made to equipment and operating systems, contributing to the better performance and thereby counteracting the tendency of riders to transfer their patronage from the existing electric transportation systems either to private automobiles or motor buses. New vehicles include the Presidents' Conference Committee car, now operating nearly 800 units in 10 cities; the trolley coach operating some 2,100 vehicles in 50 cities; and numerous installations of Diesel-electric buses. Much of the recent development in these vehicles is aimed toward providing service competitive with the private automobile. Improved power facilities permit performance paralleling the best of modern automobiles. The noise level has been reduced until these vehicles are fully as quiet as the automobile; riding qualities have been improved; control is much simpler to operate; so that compared to the older car equipments, many of which are still in use, these new electric vehicles are more attractive, more economical to operate, and thus make possible a more attractive return on the investment.

The surface street car systems, which still carry somewhat more than half the total number of riders in the United States, have available the new Presidents' Conference Committee car which has tremendously increased accelerating and braking capacity, attractive interior and exterior, light weight, and easier handling. On these systems also it has been found that many of the lighter lines can be handled by installing trolley coaches. In one city at least, the entire traffic is being handled by these vehicles.

Improvements have also been brought forth for the rapid transit systems, particularly those in New York. Several light-weight, high-capacity multiple-section trains have been placed in service by the Brooklyn Rapid Transit Corporation, making it possible to increase schedule speeds and to handle more passengers per pound of equipment.

Improved designs; light-weight, high-strength materials; and, perhaps more important than either, the ultra-modern electric motor and control equipment — all of these factors have assisted in producing lower cost vehicles with better performance characteristics.

Presidents' Conference Committee Car

The P. C. C. car is 46 feet long, weighs without load 32,000 pounds, and seats 54 passengers. A novel feature of the design aside from the electrical equipment is the extensive use of rubber in the construction of trucks and wheels to minimize noise and vibration. The construction used and the improved quality of the rubber have made it possible to greatly increase the effective bearing area and its resiliency for supporting heavy weights.

The electrical and brake equipment constitute the other outstanding features of this new car. New motors

(*Please turn to page 48*)

Thirty-five passenger Diesel-electric bus

General Electric Co.

Seeing Triple

One of two views taken in the stereographic process of three-dimensional aerial photography. The insert shows a Heidoscope camera with two lenses separated by interocular distance and with synchronized shutters

THREE-DIMENSIONAL PHOTOGRAPHY ACCOMPLISHED BY MOVING THE CAMERA, FITTING PRISMS TO THE LENS, OR EVEN ATTEMPTING TO SPLIT THE LIGHT AS IT ENTERS THE SINGLE LENS

PROFESSOR JOHN T. RULE

Massachusetts Institute of Technology Drawing Department

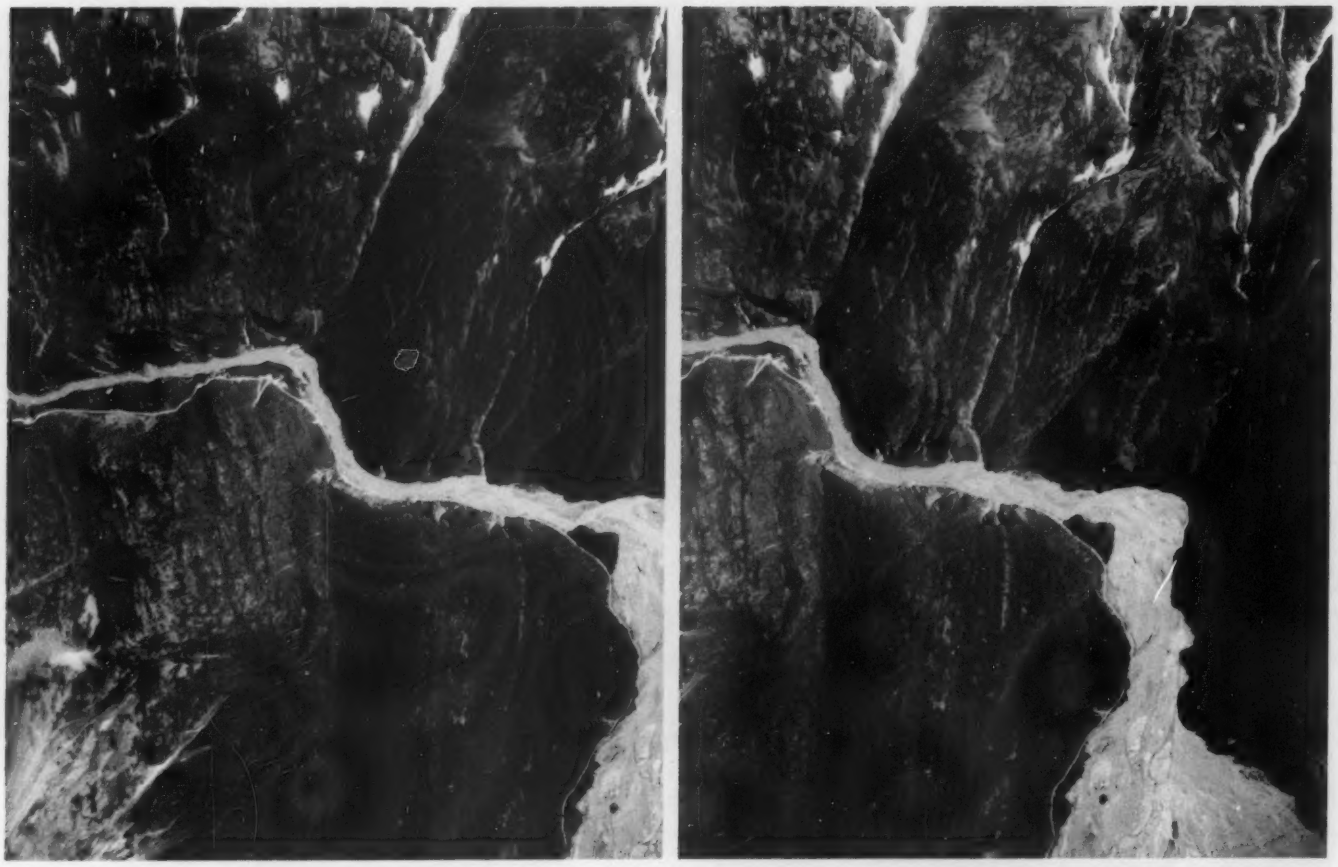
STEREOGRAPHS are virtually as old as photography itself. Credit for the development of the theory of stereoscopic vision and the invention of stereographs is generally about equally divided between Wheatstone and Brewster, who engaged in an unfortunate controversy over the matter in the 1830's. In the early days of photography sets of stereographs were extremely popular. A stereoscopic trip around the world could be found on many parlor tables. These were usually purchased from salesmen at the door. As photography itself was then a novelty and the personal camera virtually nonexistent, all photographs had to be purchased. It was quite naturally preferable to invest in three dimensions rather than in two.

A very early sample of both photography and stereoscopy is the view of "Broadway on a Rainy Day," which was copyrighted in 1859. It is No. 188 in a set known as "Anthony's Instantaneous Views." It unquestionably was taken with two cameras operated simultaneously probably with wet plates, as the dry plate dates from about that time. The use of the word "instantaneous" is now amusing, but at that time any exposure short enough to stop the motion of people walking in the rain could rightly be called "instantaneous."

When the camera became a common article, people began to take their own pictures. The stereoscopic camera was not popularized with the single lens camera chiefly because of its added cost and because the pictures taken by such cameras cannot much exceed a two and a half inch square in size. In those days this was very small. Consequently stereographs were generally taken by a single camera, shifted between views —a process just tedious and exacting enough to rule it out as a popular pastime.

Furthermore some device had to be worn at the eyes in order to view such pictures. This meant that the printing of stereographs in magazines and books was not very feasible, as unless a stereoscope was provided a great number of readers could only view them as flat pictures. Thus the impetus to develop stereoscopic photography along with flat photography was lacking on the part of the manufacturer. Thus it was more or less forgotten in the rush.

With the development of the candid camera of short focal length and small plate size, together with a grow-



Keystone Canyon in Alaska photographed twice from the air with a time interval between the shots *Bradford Washburn*

ing realization of the technical possibilities of the stereoscope, the stereograph is again growing in popularity and should eventually take its rightful place as a superior form of photography. The amateur camera addict can now go in for three-dimensional work without much added difficulty. He will find himself highly rewarded for his pains.

We are interested here in the question of how he can take stereographs, what problems he will meet in processing and viewing them, and what he can do with them that he cannot do with plane photography.

A short review of the basic principles involved is probably in order at this point. First there is no such thing as the direct perception of depth by a single eye. Each eye receives a flat picture on the surface of the retina. The difference between these two pictures, aided by judgment developed from experience, enables the brain to interpret the scenes in terms of depth. The process is instantaneous. One of the marvels of vision is the ability of the brain to fuse two different, flat pictures into one three-dimensional scene without even being conscious that two pictures are present.

The process of three-dimensional photography is nothing more than that of reproducing by means of two photographs, presented one to each eye, the exact images on the retina that the original scene would have produced. The brain must then interpret these images as a three-dimensional scene.

To do this it is only necessary to take two pictures from the two points the eyes would have occupied had they replaced the camera lenses. If these pictures are then presented to the eyes — the proper one to each eye — subtending the same solid angle as the original scene, the eyes will receive the proper images and the brain make the desired interpretation.

Obviously the simple way to do this is to purchase a stereoscopic camera, nothing more than a camera with two lenses separated by the interocular distance and with synchronized shutters. The camera shown here is a Heidoscope manufactured in Germany.

However, stereographs may be obtained with a single lens camera, or with two such cameras. A beginner in the field can do a great deal of experimental work by purchasing two cheap box cameras capable of being joined together so that the lenses are separated by three inches or less. With a little ingenuity a method of assuring a simultaneous operation of the shutters can generally be worked out. By such a system pictures of moving objects may be taken.

Most beginners would prefer to see what they can do with the single camera they already possess. Two methods are open. First, the camera may be moved a distance of two and a half to three inches between views; or second, the object may be rotated. The latter method is of course only applicable to small objects.

In the former method it is necessary to keep the camera level and oriented parallel to itself, unless objects within about six feet are to be taken, in which case the axis of the camera always should be pointed at the center of the object.

In the second method the amount of rotation should be such that a line through the object which pierces the camera lens in the first view should pass through a point two and a half to three inches to either the right or the left of the lens in the second view.

If the shift of the camera or the rotation of the object is somewhat greater than specified above, the resultant object will appear smaller and closer in the finished stereograph. If the shift or rotation is increased beyond a certain point, a hyperstereograph results,

i.e. one of exaggerated depth. This effect can be used to great advantage where such exaggeration is an advantage.

It is of course obvious that only still pictures may be taken by either of these methods as a change in position or shape of any object will be the first thing the eyes will detect in the resultant stereograph. However, the extreme sensitivity of the eyes to such change may be put to valuable use.

Two exposures of a portion of the night sky taken on different nights should appear as one perfectly flat picture if they are used as the two halves of a stereograph. If any moving object was present in the field the difference in position of its two images will be a disturbing factor immediately apparent to the eyes. In this manner comets and asteroids may be easily detected.

Professor Lemon of the University of Chicago made excellent use of this effect in a textbook of physics in which he desired to illustrate experiments which involved some important change of position or shape in a generally still scene — for instance a change of reading of a thermometer. As a stereograph the two pictures fuse and give the requisite three-dimensional effect. The eyes immediately pick out the discordant note and the attention is thus drawn to the important factor in the experiment — that which has changed.

In taking stereographs certain factors should be borne in mind. First, the effect of depth is greatly enhanced if some foreground object is included in the picture. Second, the minimum difference in depth which the eyes are able to detect between two points increases enormously as the near point recedes. Though this varies for different individuals, in general a point at 2,000 feet shows no difference from one at infinity. For photographic purposes it is a wise rule to assume that stereoscopic vision is practically nonexistent beyond 1,000 feet. Thus no depth will be detectable in scenes beyond this distance from the camera unless the distance between the lenses is increased. If the interocular distance is doubled the effect will be that of drawing the scene to half the distance and reducing its size accordingly.

In aerial photography it is customary to take pictures spaced according to the formula $d = \frac{he}{f}$

where d = distance between views
h = height of airplanes
e = interocular distance
f = focal length of lens

Extremely interesting effects can be obtained by the judicious use of this device.

In addition to the methods mentioned it is possible to design or purchase devices composed of mirrors or prisms fitting on the camera lens that split the lens into two halves each of which receives one of the necessary views, each view consequently occupying one half of the film. Zeiss manufactures such a device, called a stereoly, for their cameras. However, in general such devices have not been very satisfactory.

The use of a stereoscopic camera is of course superior to any of the single camera methods. Such cameras, with the exception of a cheap English make, are usually very expensive. No stereoscopic camera is manufactured in this country. The available makes are either German or French and are generally priced in the neighborhood of $250. It is frequently possible to find excellent second-hand ones for about $100.

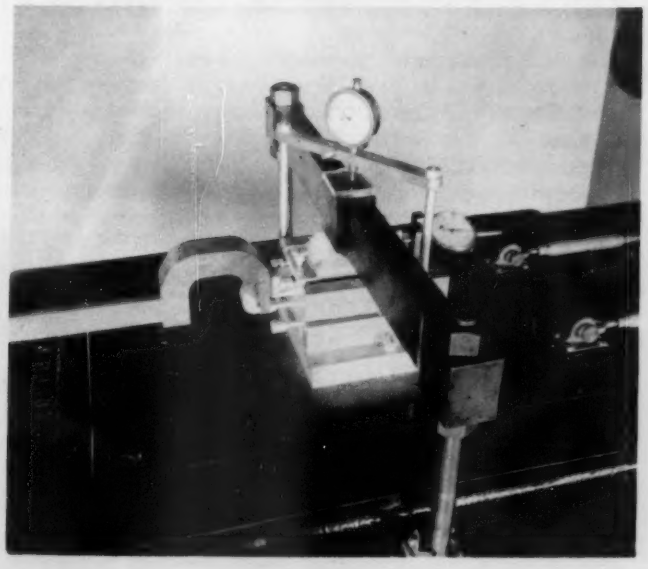
The processing of stereographs presents some problems. The things to be aimed at are, as fine a grain as possible, sharpness of detail and rather low contrast. These objectives may be obtained by methods not peculiar to stereoscopic work and consequently they need not be discussed here.

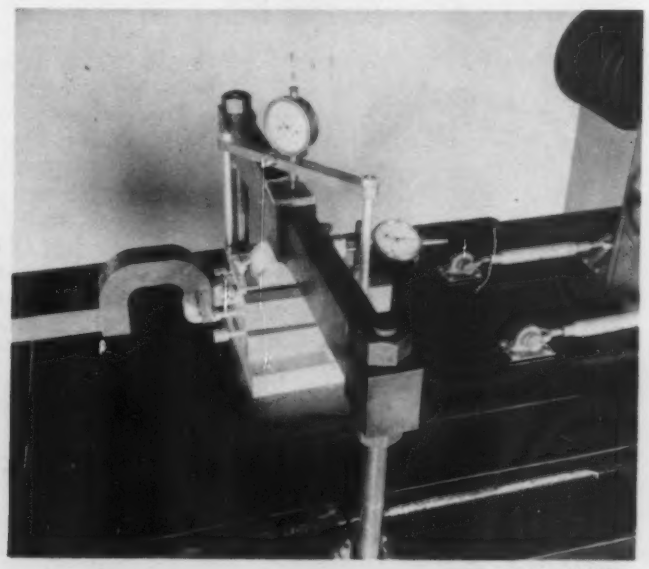
If a stereoscopic camera is used a further problem is introduced by the fact that when received on the film the two views are reversed top for bottom and right for left so that when they are made upright the picture for the right eye is on the left side. Thus some method for reversing the two views is necessary.

If paper prints are to be made the printing may be done by direct contact and the two pictures cut apart and transposed when mounted. However most stereoscopic photographers consider transparencies in which the light comes through from the rear, much superior to paper prints. As it is not very desirable to cut and

(*Please turn to page 45*)

Pictures of surveyors' machinery with camera being moved from original position for second photograph





Harold Fidler

Technology

"SENTINEL, RESTING"

Agfa Supreme
f. 4 5 1/60 sec.
Sky Filter

"CALIFORNIA JOSHUA"
Agfa Supreme
f. 12.5 1/200 sec
Sky Filter

"FISH"—BOSTON FISH PIER

f. 9 1/100 sec
Sky Filter
Agfa Supreme

"IBSEN'S 'A DOLL'S HOUSE'"

f. 2 0 1/20 sec.
Agfa Ultraspeed

"THE SNEEZE"

Agfa Supreme f. 4 1/500 sec.
Elmar 90 mm. f. 4 lens Model IIIa (G) Leica

Since the Technology page is a department of THE TECH ENGINEERING NEWS devoted to interesting accomplishments of men at the Institute, it has been decided that a page devoted each month to a set of photographs taken by some individual at our school would be in harmony with the purposes of this section. Although the photographs appearing here may sometimes not have technical subjects, they are in themselves a technical accomplishment embracing such elements as proper composition, exposure, focusing, developing, and printing. This first collection of photographs was submitted by Frank G. Denison, XIII, '40, who used, for all except the picture on the right, a LEICA MODEL IIIa (G) and a Summer f.2 lens. Next month we plan to print a group of racing plane pictures taken by Schrade Radtke. The staff of the magazine extends an invitation to all you photo-enthusiasts to send in your best shots for future use on this page and in other parts of the journal.

ELECTRICAL ENGINEER CUM LAUDE

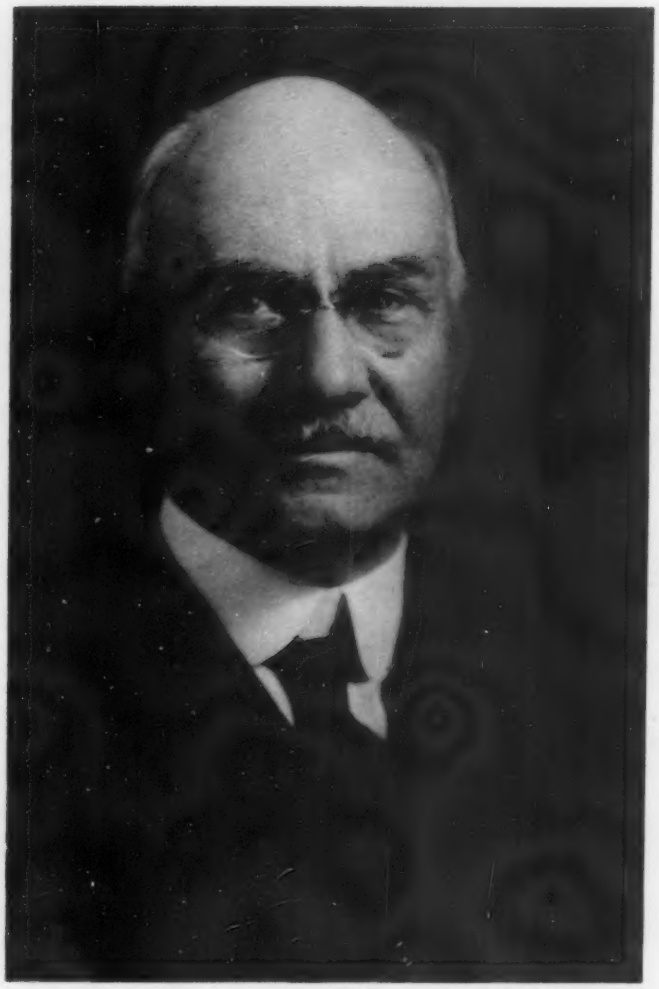
Dugald C. Jackson, Professor Emeritus of Electrical Engineering at M. I. T. and head of the department for twenty-eight years, has combined outstanding achievements in engineering fields with a seldom-equalled prominence as an educator. The best instructors, maintains Mr. Jackson, are those who keep abreast of engineering progress by their own research. Such double lives, he says, "possess real vitality when properly applied." The account of Professor Jackson's career reveals how actively he has lived up to his own criterion of a significant existence.

Mr. Jackson graduated from Penn State College in 1885, when he was twenty years old, and went to Cornell for advanced study in electrical engineering. The engineering field, when he first entered professional work, was, according to present-day standards, almost untouched. AC generating stations did not appear until 1887; high tension transmission had not yet been developed; the first electric railway went into service in 1888. Opportunities were abounding for energetic college engineering graduates.

As soon as he left college, Mr. Jackson joined two other youthful engineers in forming the successful Western Engineering Company, a consulting firm which specialized in problems of electrical power supply. All three of the boys who founded it (they were twenty-six, twenty-two, and twenty-one years old) have since become famous in their fields. After working two years with this company, Mr. Jackson accepted a position as Assistant Chief Engineer of the Sprague Electric Railway and Motor Co. Later he was affiliated with the Edison General Electric Co. (forerunner of the present General Electric) as Chief Engineer of the Central District. In these capacities he planned and supervised the construction of numerous mid-western street railway systems.

In 1891, when Mr. Jackson was only twenty-six, an offer was made him which seems to have determined the general course of his life work. At that time he was invited to organize and head a department of Electrical Engineering at the University of Wisconsin. This was the first separate department of electrical engineering to be formed in this country. Previous to this time they had all been allied with some other branch in the universities.

Mr. Jackson's entrance into the educational field was very successful. In a few years he had assembled at Wisconsin the finest instructing personnel in the



News Service, M. I. T

Professor D. C. Jackson, recipient of Edison Medal Award

country. Other institutions followed his lead in obtaining instructors who were masters of their particular fields as well as being able teachers. Professor Jackson feels that this combination of abilities is the most advantageous for the student. The purpose of the undergraduate school, he says, is not to make engineers, but to "make young men with a great capacity for becoming engineers, since greatness in engineering usually comes with years of wide experience." He does not apply this philosophy to graduate work, however.

In 1907 Professor Jackson came to M. I. T. to head the department of Electrical Engineering here. Following the same principles which had proved so successful, he elevated the department at the Institute to its present position at the head of the nation's electrical schools. One of the fundamental changes which he effected was the enlarging of the electrical engineering course. The feeling at that time was that a small department was necessary in order to maintain high standards of instruction, even though this policy excluded many students from the course. Professor Jackson denied this reasoning, maintaining that a large department was just as efficient as the small, provided that the funds available per student were not smaller. Experience has shown that he was entirely correct. The honors system of marking, introduced under Professor Jackson, was an innovation designed to allow students to acquire other than purely academic skills. The plan permits men to work by themselves with occasional guidance from the instructors.

It must not be thought that Professor Jackson had abandoned his engineering calling while he was devoting himself to educational problems. Before accepting any educational position, he stipulated that he must be allowed to continue his engineering practice. In 1894 he had formed with his brother the firm of D. C. and William B. Jackson. As consulting engineers, their work was largely with light and power companies. Mr. Jackson was the confidential adviser to many leaders in the utilities field. He was selected in 1911 by the British government to assist them in taking over a privately owned telephone system.

During the war Mr. Jackson, a lieutenant-colonel in the engineers, practically moved his engineering office overseas where he was chief engineer in charge of the power supply for all American war activities outside of the immediate fighting zone. For these services he was made a Chevalier of the Legion of Honor. After the armistice he was chief engineer of a special board to determine property damage caused by the war in Allied countries.

After the war Mr. Jackson and E. L. Moreland, the present Dean of Engineering at Tech, organized the firm of Jackson & Moreland. In this partnership Professor Jackson investigated and gave advice on many important engineering projects. The Conowingo hydroelectric development on the Susquehanna River and the nineteen mile Falls project on the Connecticut River were among those analyzed favorably. It is interesting to note that the firm also investigated the feasibility of the proposed tidal power development on Passamaquoddy Bay. They reported unfavorably on the proposal. Mr. Jackson was also instrumental in the electrification of the Great Northern Railway through the Cascade Mountains and the conversion of the Lackawanna system outside Hoboken, N. J. to electric power.

He is patentee of numerous electrical devices, including the repulsion motor with closed coil armature, in general use wherever a repulsion motor is required, and the squirrel-cage motor. He is chiefly noted, however, for leadership in the field of electrical power, generation, and transmission.

In 1929 Professor Jackson gave up his engineering practice, and in 1935 he retired from the Institute. Particularly appropriate to Professor Jackson's career is the Edison Medal Award, made a few weeks ago. For the first time in its history the medal was given for outstanding work in engineering education as well as engineering practice.

Professor Jackson is remembered for more than his splendid achievements. The ability to get at the essentials of any problem has made him successful with any task he has attempted. Apart from this is the personal impression he leaves with everyone with whom he comes in contact. Few people meet Dugald C. Jackson who are not deeply and favorably impressed.

Professor Jackson was consulted for construction of several electrical transmission lines

HIGH-VOLTAGE X-RAY GENERATORS FOR CANCER TREATMENT

For a number of years the development of very high voltage X-ray generators for use in cancer treatment has been carried on at the Institute. These X-ray generators utilize the electrostatic generator invented by the Institute's Robert J. Van de Graaff as their high-voltage source. This new type of electrostatic generator is a fundamentally simple and direct means of producing high constant potentials. Essentially a belt conveyor of electricity, it is provided with a well-rounded metal terminal insulated from ground, to which electric charge is continuously transferred by means of the moving belt. In this way a steady current under high constant potential can be maintained in an X-ray tube or other useful load. Generators of this type have been widely adopted for research on the atomic nucleus and in the course of this work have produced the highest voltages to ground yet attained by any voltage source. The X-ray program followed the recognition that this new voltage source, coupled with the vacuum and charged-particle acceleration techniques developed in Institute laboratories, made possible the development of exceedingly penetrating X-rays long needed by the medical profession for the more effective treatment of deep-seated malignancies.

The two accepted methods of cancer treatment, both of which involve the removal or the destruction of the cancerous tissue, are surgery and irradiation. These treatment techniques — the result of all previous research and experience — are at present directed with only a fair degree of success at the treatment of a disease which ranks second as a cause of death, accounting for 10 per cent or about 135,000 of the annual mortality in the United States. Radiation, which includes the use of X-radiation and the radiations from radium and its products, is steadily occupying a place of increasing importance in cancer therapy. In 1934 over 75 per cent of the cancer patients in England, for example, were treated with radiation. Most commercially available X-ray therapy apparatus operates at 200 kv, though a few 400-kv installations and some of still higher ratings are now in use. The present X-radiation sources fall far short of approaching the wave-length and penetrating power of the gamma rays of radium, but have enormous advantages in availability and cost. Throughout the world only about 160 grams of radium, distributed among approximately fifty hospitals and acquired at costs which have averaged somewhat greater than $50,000 per gram, are available for radium beam therapy. An approximately equal amount is used in radium needle and plaque therapy. In spite of the investment of millions of dollars in radium and in facilities, the more than thirty years of application and research by radiologists have been severely limited by the gross inadequacy of the radium supply and the consequent low gamma-ray intensity available at any one place.

The biological effect of X-rays is due to the photoelectrons and recoil electrons produced when the X-rays are absorbed within the tissue. These secondary particles, because of their high energy, have a destructive effect on cell tissue. The electromagnetic radiation therefore serves simply as the vehicle for carrying into the volume of the body the high-energy electrons which

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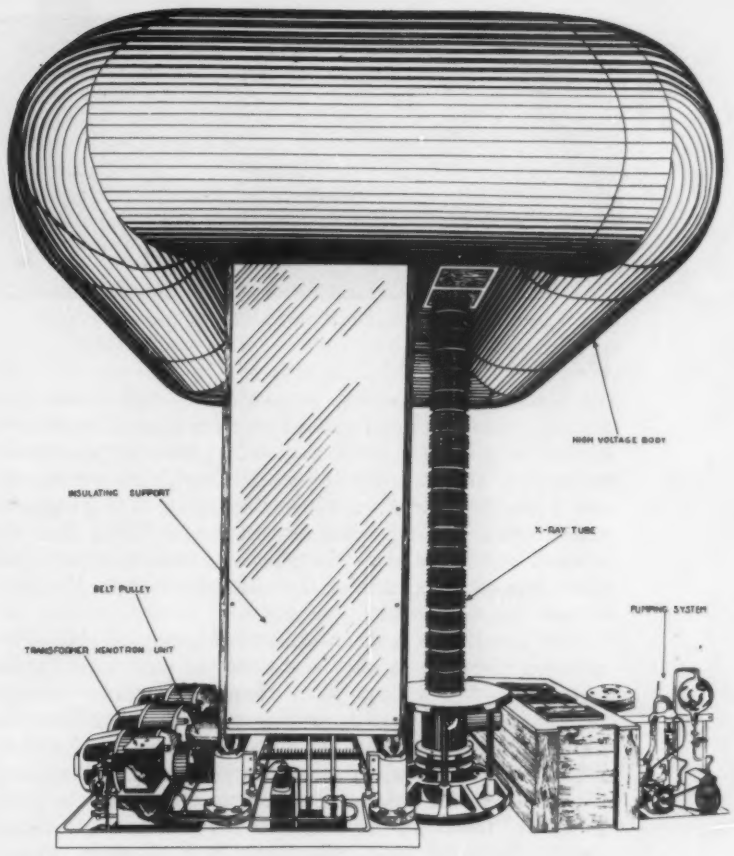
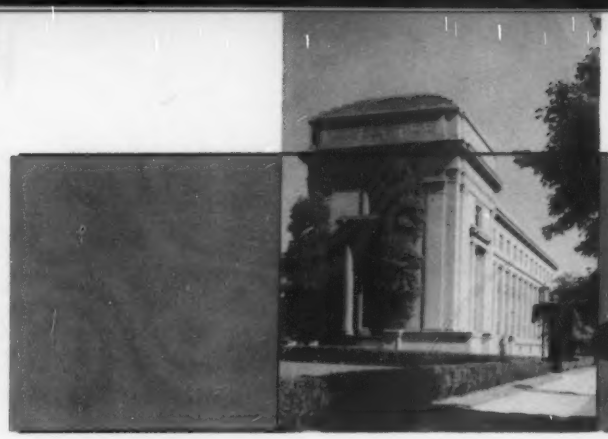


Apparatus for producing X-rays used to treat patient in the room below



Technology

DESIDERATA

Some understanding person once remarked, facetiously, that the activities of an educational institution obey the laws of a perfect gas, i.e., they expand freely to occupy all available space. Perhaps this person was one who, like our invaluable Registrar, was frequently called upon to find space for new activities. But this remark can be used as the text of a much more significant aspect of educational institutions than the mere occupation of space.

Given a large, well co-ordinated group of able scholars and pioneers in the vast fields of pure and applied science, and associate with them a carefully selected body of students and apprentices, there is no *theoretical* limit to the things they might accomplish for the direct benefit of society and, at the same time, for their own satisfaction. But there is a *practical* limit to the possibilities of their accomplishment set by the limitation of the facilities at their disposal. Just as new space is quickly occupied, so also are other facilities quickly made use of to the limit.

The function of the administrators of such institutions is primarily twofold: first, to insure the best possible competence in personnel; second, to secure the best possible facilities for their use. Of necessity these things must be accomplished step by step, and there are both successes and failures in the process. It is believed that no technological institution has ever even approximated a realization of the inherent possibilities of its service to society.

The recent report of the President to the Corporation of M. I. T. emphasized some of the important desiderata for this institution in coming nearer to its ideals of possible accomplishment. "Having devoted strenuous efforts in the past year to bringing into healthy balance the recreational opportunities for our students, even though these efforts only partially attained their objectives, and having our physical plant now in relatively adequate condition, I would suggest that our thoughts for future improvement follow other channels for the time being."

Harvard has 103 endowed professorships, Yale 79, Oxford 62, Columbia 58, Cambridge 49, Princeton 36, Chicago 21. M. I. T., despite its fine physical plant and educational program, has none! Here is surely an opportunity to make some permanent contributions to the competence of our staff. An Elihu Thomson professorship was started, but has had to be held in abeyance during the depression. Many alumni have pointed out the appropriateness of a professorship endowed in honor of our great "builder-President," Dr. Maclaurin.

Taking all elements into consideration (expenses, share of staff salaries, etc.), it is estimated that M. I. T. spends about twenty per cent of its budget for research by staff and students. Part of this comes from funds specially provided for the purpose by outside agencies, and part comes from general Institute funds. It is certain that largely increased funds for this work would enormously increase the value of the Institute's accomplishments; for research contributes not only to increase knowledge and to aid industry, agriculture, medicine and general standard of living, but research can also be used as the most stimulating and disciplining of all educational methods.

New scholarship and fellowship funds can always be used to advantage to advance toward the ideal of student enrollment — selection on the basis of ability, character, and promise and not on the basis of the family bank account. Particularly urgent just now are some postgraduate fellowships to be awarded annually to the best of that large group of able graduate students who are trying to earn their postgraduate education by part-time laboratory instruction or assistantships.

Such are some of the desiderata which could strengthen the Institute at particularly strategic points at the present time. "The social value of the Institute's objectives justifies all our combined efforts to carry them forward."*

KARL T. COMPTON,
President

PROGRESS?

A news despatch of recent date tells of the disturbing testimony given before Senator O'Mahoney's Monopoly Investigation Committee. The president of one of the largest industrial electrical research laboratories in the world testified that his laboratories had developed — sixteen years ago — a telephone receiving tube whose life was from twenty to fifty times that of the ordinary commercial radio tube! Despite cross-licensing agreements between the research laboratories and two of the largest radio tube manufacturers in this country, and despite the fact that most reports indicate that the telephone tube could easily be adapted to radio use, these radio tube manufacturers have made no apparent effort to introduce this new tube! By way of explanation it should be pointed out that the research laboratories are a part of a very large system which not only operates throughout the country but has all its equipment manufactured by one of its own subsidiaries. But why has the tube not been made available to the public?

This problem is one that has long perplexed the layman, for the case illustrated above is not an isolated and infrequent one. In the same inquiry, a manufacturer of automotive parts asked for legal action against one of the country's largest manufacturers of automobiles, because the automobile producer bought the rights to an oil filter twelve years ago and then put on a dummy filter box that was of no actual value. This was just another case of a real mechanical improvement being withheld from the public for whom it was intended. Is this real progress?

The rapid industrial progress of the nineteenth century was the result of the immediate marketing of new developments. Now in the twentieth century, when

*Quotations are from the President's Report for 1938.

industrial progress, through the large well-equipped research laboratories, is as well organized as is industry itself, developments are not given to the people. It is common knowledge among technical and scientific men that these research laboratories are about a decade ahead of the products being offered commercially. The reason for this is obvious; in Senator O'Mahoney's investigation the reason was very well put in response to the question of whether or not anybody was licensed to make the long-life tube: "It would not be commercially to their (the radio tube manufacturers) advantage to do it." But, again, is this progress? Do not such tactics as these defeat the whole purpose of real science?

The greatest thing that a scientist can do is to contribute to the progress of civilization and by this is meant, primarily, industrial civilization. However, much of the fine work that the scientist does is nullified because the concern for which he works and which owns his work does not consider it "commercially to their advantage" to present the product to the public. In some cases the new product would greatly reduce the income on the equipment being replaced. At other times — such as the oil filter case — allied industries can exert enough pressure to restrict the use of an industrial development.

If the consumer is to benefit from technological advances, some control must be applied. The Senate Monopoly Investigation Committee has as its objective the breaking of the monopolies that withhold the product of the research laboratory from general use. A free and open competition would force more immediate introduction of new developments, and civilization would benefit all around.

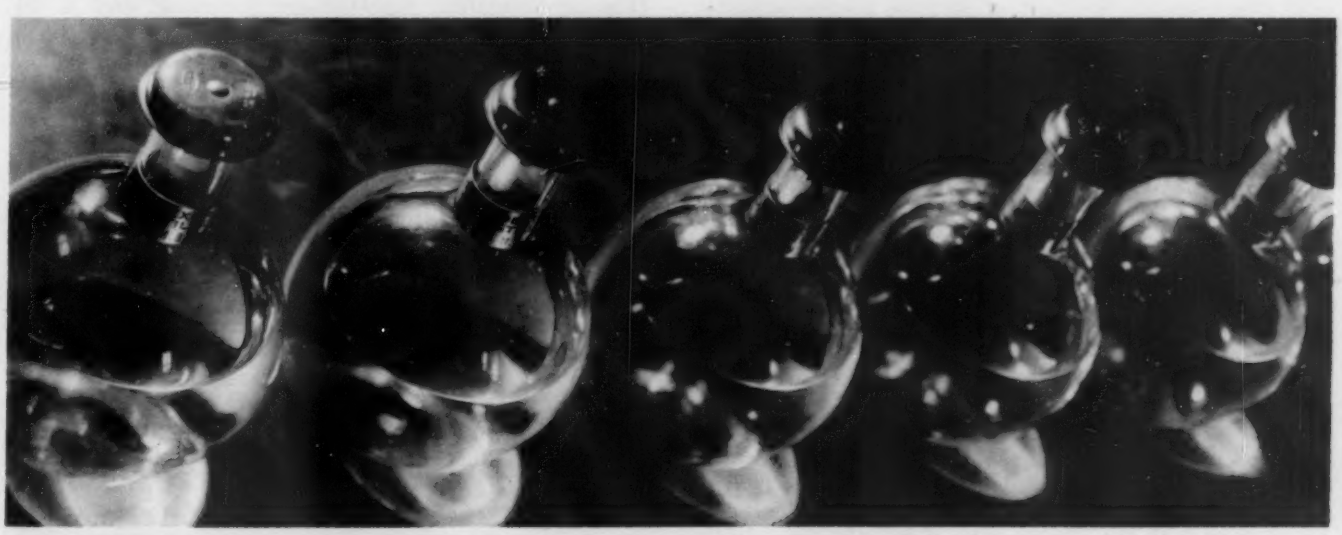
OUR FOREIGN POLICY — DICTATED OR LEGISLATED?

A recent airline accident on the Pacific Coast brought a fortunate though embarrassing revelation to public attention: namely, that a member of the French Air Mission was a passenger on the Curtiss Bomber which crashed. Immediate investigation disclosed the startling situation that our President was conducting private negotiations for the sale of fighting planes to the French government. A great deal of unfavorable comment has followed; President Roosevelt has slipped off on a Caribbean cruise; and the sale of the fighting ships to France will stand unless Congress acts against it. This incident is not one to be lightly considered and forgotten, for it has embraced and contradicted many elements of our foreign policy—both past, present, and future.

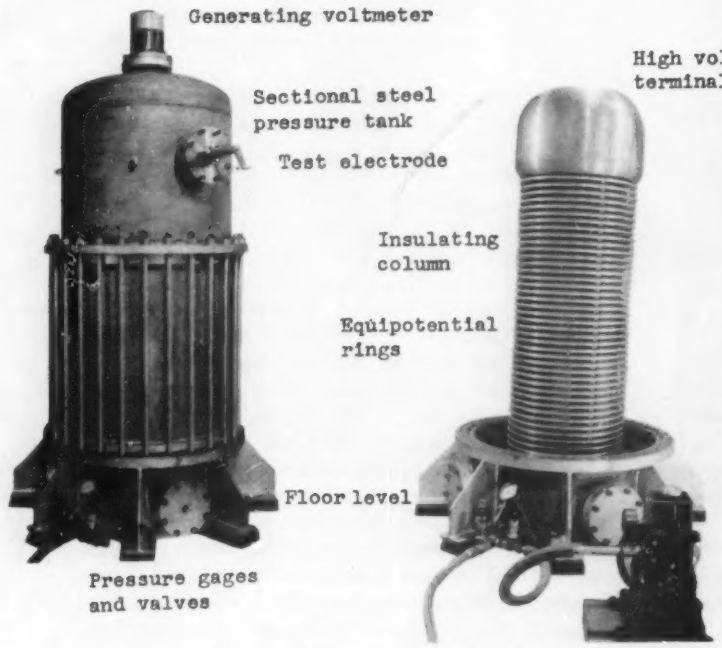
A sale such as this is enhanced by no subtleties. It is obviously and without question a foreign sale of materials that can be used for only one thing — war. Bombing planes and military pursuit ships cannot possibly be employed for normal domestic air traffic. They are built to rain destruction, spread terror, and intimidate foreign powers.

Why this sudden change from strict neutrality and Monroe Doctrine ideals? Was it not only a few months ago that we refused the sale of helium to Germany on the basis of fearing its use for war purposes? Yet Germany clearly revealed what her exact uses for the helium would be. The German Zeppelin Company wished to purchase 10,000,000 cubic feet of helium to be used in making fifteen to twenty-five round trip trans-Atlantic passenger voyages from Frankfurt-on-Main to Lakehurst, New Jersey or Opa Locka, Florida. So, on the recommendation of Secretary of Interior Ickes, the United States Government refused to sell to the German company because the helium might be used for military purposes. Despite the fact that our Government believes the zeppelin to be of little use in offensive military maneuvers, it still refuses to co-operate with Germany. Pioneering and major progress in lighter-than-air craft may be credited to the engineers of that country. Now, when scientific advancement and commercial expansion in this field of speedy, safe, convenient air travel is handicapped by a dearth of helium, our Government officials hide their selfish prejudices behind a superficial veil of military fears.

I ask you, what type of neutrality policy have we in our country? Is it to be dictated by the personal prejudices of some few politicians, or is it to be legislated by common sense endowed with a scientific attitude? When our policy is dictated, we know not where we stand, especially when the latest style of dictated foreign policy seems to be one of secrecy. How are we to be proud of our Government — a pride taught us from our first days of schooling — when it attempts to put our frontier on the west bank of the Rhine by trying to arrange a secret sale of military planes to France? It is most confusing and difficult to admire Roosevelt first as Chancellor of Neutrality and then as Secret Sales Manager of War Supplies to Foreign Powers.



Clarke & Marks Co.



Pressure insulated X-Ray Generator shown assembled and with tank removed

HIGH-VOLTAGE X-RAY GENERATORS FOR CANCER TREATMENT

(*Continued from page 39*)

are the active therapeutic agents. One of the fundamental limitations of X-ray therapy is the fact that the radiation cannot be definitely localized but must proceed through the body with an intensity which diminishes in accordance with the law of absorption and the inverse-square law. Since in cancer therapy the beam of X-rays passes through and has a destructive action on both malignant and healthy tissue, the beneficial effect of such treatment depends upon the small differential between these two effects. In the treatment of deep-seated malignancy the limit on the amount of radiation which can be applied to diseased tissue is usually defined by the tolerance of the intervening healthy tissue, particularly of the skin. The problem of X-ray therapy is to increase as far as possible the proportion of the dose applied to the tumor relative to the dose sustained by the skin, that is to say, the depth dose. This can be done in several ways:

(1) by irradiating deep-seated malignancies with a long target-to-skin distance so that the inverse-square-law diminution in X-ray intensity from the skin to the tumor will be small;

(2) by irradiating deep-seated malignancies from several angles, the beam always passing through the diseased tissue but passing through the healthy tissue only a fraction of the time;

(3) by the use of a more penetrating, that is to say, a higher voltage X-radiation.

This last purely geometric and thoroughly understood characteristic of high-voltage radiation is one of the two chief reasons for the present tendency to go to higher voltages for deep X-ray therapy. The second reason for the tendency toward higher voltages is based on the belief held by many radiologists that the shorter wavelengths are in themselves, apart from any depth-dose considerations, more relatively destructive in their effect on diseased cell tissue. This belief in the greater radiosensitivity of diseased tissue to shorter wavelengths was originally based on the observations made by workers with the gamma rays of radium, and within the last few years has been strongly supported by roentgenologists who had available X-ray units of 400 kv and higher.

For many years, scientific and industrial institutions interested in the problem of X-ray therapy have been developing apparatus of progressively higher voltage ratings. The chief differences between these lie in the high-voltage source, which consisted of transformers, transformer rectifiers, surge generators, high-frequency oscillators, and now electrostatic generators. Following experimental work at the Institute in 1934 and 1935, a constant-potential, million-volt X-ray generator employing an electrostatic high-voltage source was developed for the Huntington Memorial Hospital of the Harvard Medical School. This machine, which operates at the highest effective voltage now applied to cancer therapy, has been in use since March, 1937, over 600 completed treatment series, totaling about 9,000 individual treatments, having been given to date. The air-insulated, high-voltage generator and X-ray tube, which is housed in a room 25 by 23 by 20½ feet high, is shown in Figure 1. The treatment room, in which the grounded target end of the X-ray tube terminates, is shown in Figure 2. The uniqueness of the Huntington Hospital installation as a source of penetrating X-rays for deep-seated cancer therapy and the program of clinical treatment and research which has been carried on with this apparatus under the direction of Dr. Richard Dresser have aroused much interest among medical circles. While years of clinical research are needed to fully establish the merits of such penetrating radiation, the preliminary evidence is that the higher-voltage X-rays are more effective as a palliative measure, are practically unattended by any adverse physiological reaction during or immediately after treatment, and are apparently considerably more effective in the cure of certain types of deep-seated malignancy.

As the next step in this medical radiation program,

(*Please turn to page 44*)

PACKS OF TWENTY

(*Continued from page 30*)

the alcohol family, diethylene glycol. This particular chemical supposedly causes less throat irritation than the glycerin in "other popular priced brands." One cigarette concern claims that its product has definite properties which give a "lift," an assertion based on the experimental fact that nicotine stimulates the adrenal glands and causes them to excrete adrenalin, which in turn causes the release of sugar and the consequent upswing of one's energy.

After the redrying, blending, and flavoring, the tobacco is about to take the form of the finished product. A large part of the machines through which the tobacco and paper become the cigarette are made by the Molins Co. of England. Each machine costs the tobacco manufacturer about $7,000, and is capable of making a half million cigarettes in less than eight hours. They are the product of years of experience on the part of the engineer and are, as a rule, a pleasant solution to the many problems usually present in the manufacture of cigarettes. The problems include variances in weight, size, and joint — qualities which are now easily controlled by the inspector and operator. The tobacco, in carefully regulated amounts, is dropped continuously onto a fast moving strip of white paper about an inch wide, which has just received the stamp of the particular company. One edge of the paper is then touched with a casein paste made from milk and the edge is folded and ironed into position. Then still traveling at a rate of something over 160 centimeters per second the "endless" cigarette enters the compartment where it is cut into seven centimeter lengths. The knife employed for this purpose is held in position on one end of its carriage, which is about 30 centimeters long, and counterbalanced at the other end. This carriage revolves about its center at a speed of over 20 revolutions per second. Since the industry's requirements demand that each cigarette made have a clean cut edge, the knife itself must be kept constantly sharp. With every revolution the edge of the knife contacts a stiff abrasive cloth which is glued in place over a small wheel about one inch radius free to rotate about its center. This continuous contact with the abrasive keeps the edge of the knife in a satisfactorily sharpened condition. From the edge of the knife the cigarettes are transferred to a belt which moves them into full view of the inspector, where they are given constant inspection. They are examined for irregularities in length, weight, cut, print, and thickness, and then, after a recheck, they are carried to a machine which is a product of all that the engineer's ingenuity can devise. In simultaneous operations the groups of twenty cigarettes are wrapped in tin foil and are wrapped with the company label, while an "automatic detector" rejects any pack which contains a defect in any cigarette. This detector is a group of twenty metal fingers which, when thrust against the top of the open pack, are consequently depressed; hence it can "feel out" almost any defective cigarette, since in such a case one "finger" is not depressed and the whole pack is thrown into discard. All the while other packs are receiving the costly revenue stamp and a jacket of cellophane.

Constant research is aiming for a cigarette with no harsh qualities. Experiments with various flavorings and hygroscopic agents are carried on day by day. Half of the laboratory time of one company is spent upon research in fields of handling, processing, and blending; one fourth of the time is spent analyzing tobacco samples; and the remaining fourth spent directing and controlling the company's purchase of various products.

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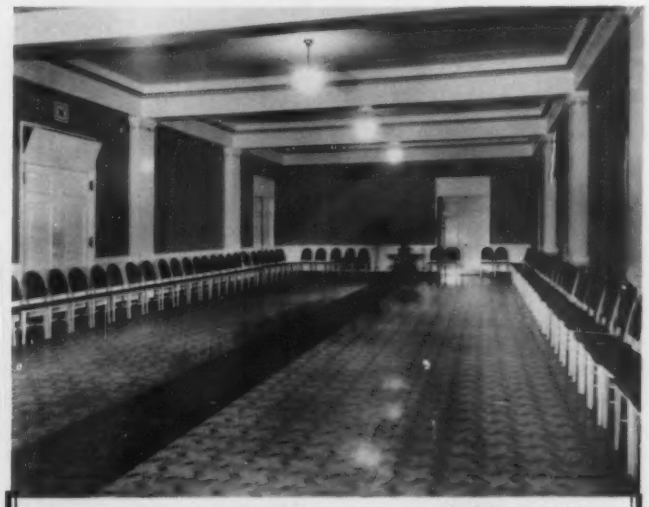


NORTH HALL

Activity Leaders . . .

Why Go Elsewhere?

HOLD YOUR BANQUETS IN A PRIVATE DINING ROOM IN

WALKER MEMORIAL

The laboratories of the various concerns are usually in two divisions, one division testing the chemical, the other the physical characteristics of the cigarette. It is usually their duty to guard such characteristics as the circumference of cigarette, density of packing, moisture content, and flavor. Most of the time is spent on the tobacco as it passes through the different stages of treatment.

The quality of paper has a great deal to do with the cigarette. Although a great per cent of cigarette paper is French made, the American companies are slowly changing over to American made paper. The paper itself must meet certain requirements in that it must be absolutely pure and free of any irritating qualities, it must contain tiny microscopic air passages to insure uniform combustion, and must burn evenly. One firm employs a mechanical lung which is used to reproduce very faithfully the human actions of smoking, notably that the average puff contains 35 cc of smoke, the smoke moves through the cigarette at a rate of 17 cc per second, the first portion of each puff is stronger than the last, and that the average cigarette lasts ten minutes. The tests run on this apparatus are considered very important in the companies' research because they show the chemical as well as physical properties of the cigarette under very nearly the same circumstances as when the cigarette is actually smoked. The companies gain much from experience in the research laboratory by constantly experimenting toward improvement in the characteristics of paper and tobacco.

The United States Department of Agriculture, along with the agricultural departments of various universities and colleges, has, in past years, directed quite a bit of effort toward the perfection of a better tobacco plant, a factor which is the basic and most important in the making of the cigarette. The prevention and eradication of diseases and insects which are detrimental to the plant has been their primary interest since the work began. The tobacco itself is grown as a main crop on a majority of the farms in the central Southern States. The plant is very "delicate" in the sense that it must be handled with the greatest of care, a characteristic which is largely responsible for the fact that the college and government research laboratories have found it necessary to come to the farmer's aid. As a result of their constant warfare against the diseases, etc. to which the plant is subjected, today, with much caution and no small amount of luck, the farmer is able to produce a crop of tobacco which is well worthy of the name. In the spring of the year from a carefully prepared seed bed he removes short seedlings which are the product of the tobacco seeds which were planted a month or so before at the close of winter. These are set into the ground row upon row, and, before a great many weeks, the plants are waist high. Their rapid growth at this stage does not lessen the fact that they require year round attention, neglect usually spelling failure. However, with much care and favorable weather conditions the tobacco is ready for curing before the summer is over. In the tobacco barns which dot the Southern countryside the leaf is kept at a fairly constant high temperature for about two days, a step which, being one of the most important, requires constant vigilance. The slightest spark might set the entire barn and its contents off like a box of tinder — six months of labor lost. After the leaf is thoroughly dried, the barn is slowly cooled down, and the tobacco once more becomes soft and pliable and is ready for market.

As described before, the tobacco now passes from farmer to auctioneer to warehouseman to manufacturer, until at last as the finished product, in packs of twenty, it begins existence as one of America's chief pleasure sources.

Testing cross sectional area of cigarettes

HIGH-VOLTAGE X-RAY GENERATORS FOR CANCER TREATMENT

(*Continued from page 42*)

the development of a pressure-insulated X-ray generator of about the same voltage and X-ray intensity as the Huntington Memorial Hospital generator was undertaken by the Institute.

The new generator is contained in a steel tank, which has a 34-inch inside diameter and a 100-inch height, containing air at pressures up to ten atmospheres gauge. This tank can be housed in less than 10 per cent of the space required for the atmospheric air-insulated Huntington generator. A substantial increase in voltage can be obtained from the use of dichlorodifluoromethane instead of air.

In its research program on high energy radiation the Institute is interested in the scientific development of a now unavailable medically useful radiation. The reproduction of its developed apparatus, if warranted, would be undertaken by commercial X-ray organizations. The X-ray generator on which the development is made is now being applied to the study of the insulating properties of gases at high pressure, and of the characteristics of the penetrating X-radiation produced. The generator is also being applied in a preliminary way to various biological studies at the Institute, and it is probable that some clinical use will be made of the machine within the next few months by the medical group of the Massachusetts General Hospital. It will finally be installed for regular use in cancer therapy in the new George Robert White Memorial Hospital of the Massachusetts General Hospital group.

The development outlined above is part of a broad medical program of the Institute based on the original contribution to the high-voltage art by R. J. Van de Graaff. The X-radiation group consists of Robert W. Cloud, Augustus T. Norton, Jr., Francis J. Safford, and J. G. Trump, of the Electrical Engineering Department. Much of this work on electrostatic X-ray generators for medical use has been made possible through generous grants, both to Harvard University and to the Institute, by the Godfrey M. Hyams Trust.

JOHN G. TRUMP,
Assistant Professor, Electrical Engineering.

SEEING TRIPLE

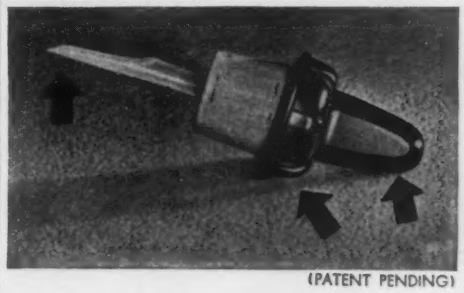
(*Continued from page 35*)

transpose the positive film used for such work, a transposing frame usually is resorted to. This is a small box one and a half times as long as the negative with the central one-third open. When the unexposed positive is put in one side and the negative in the other they overlap for one half their length. An exposure may be made and the film and negative each slid to the opposite end for a second exposure. This accomplishes the desired transposition.

Some consideration must be given to adjusting the size of the positive to the stereoscope to be used in viewing. For orthostereoscopic viewing, i.e. for the stereoscopic image to have the same shape, size, and location as the original space scene (an ideal never completely attained), the focal length of the stereoscope should equal the focal length of the camera. If this is not the case, and stereoscopes tend to have the longer focal length, the positive should be enlarged in the ratio of the focal lengths.

We have now given a simple outline of stereoscopic methods. There is no great difficulty involved in any of this. Any amateur with a camera can certainly make stereographs of still scenes by the shift method. If he cares to he can tackle the more difficult problem of devising a method of splitting the light as it enters the single lens of his camera.

In any case he immediately finds himself in a fascinating field, containing many variables and unknowns, that offers excellent opportunities for showing his ingenuity and imagination. He naturally wants to know what the artistic and practical possibilities are and what results he can obtain that he cannot obtain by flat photography.



(PATENT PENDING)

HIGGINS brings you a new stopper for your greater convenience

This improved quill stopper has been adopted for the famous Higgins Drawing Ink desk bottle to add to its convenience and safety. Its several new features are as follows:

1 Shoulder ridges make stopper easy to grip for turning to remove from bottle neck and prevent rolling when stopper is placed on a sloping drawing table.
2 Stopper is weighted so it always rests with point of quill up.
3 Flat side on steeple provides a thumb rest which is so arranged that open face of quill is always uppermost when thumb is placed upon it, thus guarding against spilling.
4 Quills are genuine feather quills which will not splinter or break and are just right to take up enough ink for one filling of ruling pen.
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New stoppers and empty bottles may be purchased from your College Store or Stationer

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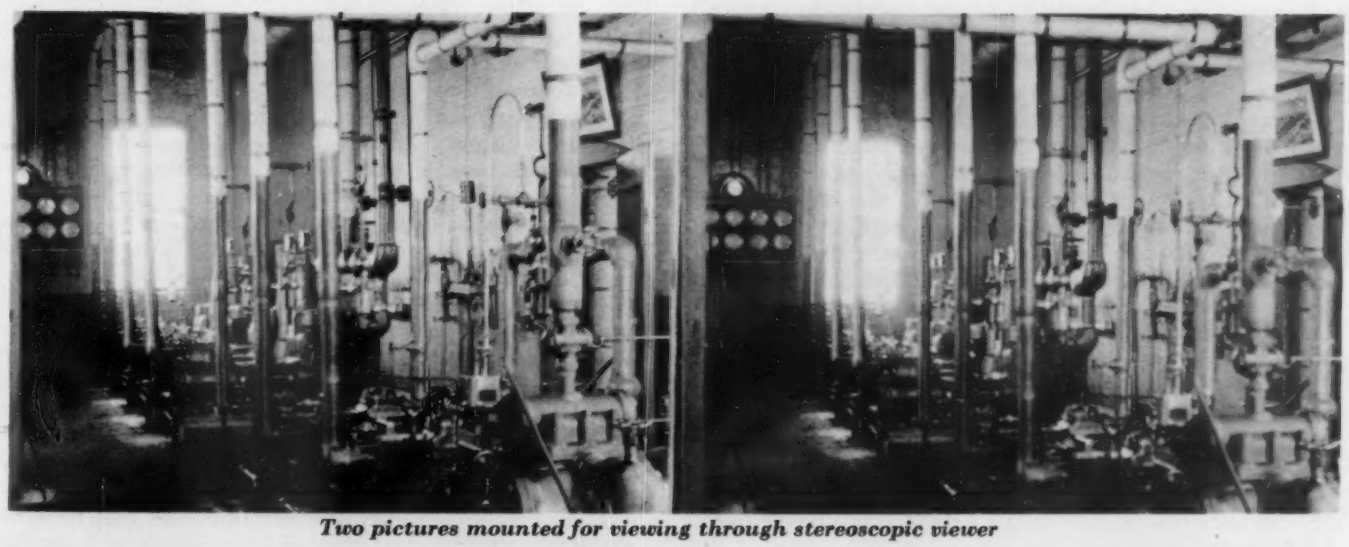

Two pictures mounted for viewing through stereoscopic viewer

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Made of extra quality cotton yarn, carefully inspected, and guaranteed free from all imperfections of braid or finish.
The colored spots are our trade-mark, used only with this quality.
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TECH MEN AT SIMPLEX WIRE AND CABLE CO.

Advertising in an undergraduate publication such as THE TECH ENGINEERING NEWS has many far reaching effects that are not too obvious to the casual observer. First impressions are often the deepest and longest remembered. Because of this fact, it is important for advertisers to make every effort to display their product before the engineer while he is still a student with an unprejudiced mind constantly being molded by impressions. Not only is the advertiser bringing favorable influence to bear on the future buyers of his products, but he is gaining the respect of potential employees of his company. The services of Institute engineers in the employment of any company are of much greater value than the purchasing power they may hold for the product. The list of Tech men employed by the Simplex Wire and Cable Company — for many years an advertiser in THE TECH ENGINEERING NEWS — should be of interest since it shows the valuable personnel that may be attracted with the aid of advertising media.

Name	*Course*	*Degree*	*Year*
Alexander, S. N. Electrical Research Laboratory	VI	M.S.	1933
Anderson, Walter A. Factory Foreman	XV-2	B.S.	1928
Blake, John T. Chief Research Chemist	V	Ph.D.	1924
Boggs, Charles R. Vice-President, General Manager	V	B.S.	1905
Bolles, Kenneth R. Electrical Engineering Department	VI-A	B.S. and M.S.	1931

Space limitations do not permit a complete investigation of the field here, but a few suggestions can be made which will indicate the possibilities.

The important thing to realize is that depth has a very powerful fascination. Nearly everyone thoroughly enjoys stereographs. The artistic possibilities of such a tool need thorough investigation, yet the fact is that very little intelligent experimentation with depth effects in stereographs has been done. There are two or three ways in which depth may be exaggerated and the various effects observed. An increase of lens separation is the only one of these that has received any attention and this usually only for technical purposes.

Relative depth may be exaggerated by using a stereoscope of a longer focal length than that of the camera lens or by reduction in picture size. For the photographer who is interested in photography as an art the variation of artistic effect that can be obtained by a skillful use of these devices is a field that has never been investigated at all.

Many other fields of investigation may be suggested. Though it is possible to calculate the size and location of a stereoscopic image on geometric principles, the fact is that the brain does not interpret a stereograph geometrically. It does somehow instantaneously interpret one as being the image of a scene of a certain size and shape and at a certain distance. The factors involved in this interpretation are very poorly understood. Since the brain makes the interpretation subjectively from the evidence received from the eyes and does no conscious geometric calculating, it is quite obvious that any factor present may very possibly effect the interpretation. For instance there is reason to suspect that paper textures and enclosing frames have a very definite effect on the image location. Work needs to be done on the subject. Series of pictures using various papers, differing contrasts, and variable-size enclosing frames might lead to valuable information.

The commercial possibilities of stereographs have not been thoroughly developed in this country though a great deal has been done in England. Factory layouts, particularly where many machines are present, yield excellent stereographs for advertising purposes, giving a much better impression of relative position than a flat picture can possibly do. The picture of a refrigeration plant shown here is an excellent example of this.

All manufactured products that are sold by direct contact between the salesman and the customer, yet which are impossible to carry as samples, can be excellently shown by means of stereographs. Heavy machinery, heating installation, boiler rooms, etc., fall in this class. Beyond any question a stereograph will give a potential customer an infinitely better idea of the product than the best of flat photographs. Yet very little of this sort of thing has been done in America. It should offer attractive opportunities for an energetic photographer to break into the commercial field. A salesman presenting a stereoscope and three-dimensional views should get instant attention.

Stereoscopic portraiture is another untouched field. The factors which give character to a face are so minute and subtle in their nature that the slightest alteration may destroy them or change their effect. Flattening a face into two dimensions, even though the shades and shadows indicate the third, frequently so changes

Name	*Course*	*Degree*	*Year*
Bruce, Philip L. Research Chemist	V	M.S.	1932
Couch, W. H. Chief Chemist	X	B.S.	1924
Crabbe, Gordon Maintenance Department	VI	B.S.	1925
Davis, E. W. Chief Electrical Engineer	VI	B.S.	1912
Elmer, Charles W. In charge Estimating Department	VI	B.S.	1904
Evans, Ralph R. Department Superintendent	X	B.S.	1921
Fallwell, Jr., Franklin Research Chemist	V	Ph.D.	1938
Fannon, Joseph L. Electrical Engineering Department	VI-A	B.S. and M.S.	1926
Follansbee, E. M. Technical Superintendent	X	B.S.	1911
Fowler, Bryant Draftsman	II		1936
Kenney, Norwood Electrical Engineering Department	VI	B.S.	1930
Kitchin, D. W. Electrical Research Laboratory	V	B.S.	1921
Loomis, Aaron A. Efficiency Department	XV	B.S.	1936
Merrick, L. Chemical Laboratory	X	B.S.	1927
Mitropoulos, Theodore Electrical Testing Department	VI	B.S.	1936
Morss, Jr., Henry A. Engineering Department	VIII	Ph.D.	1936
Phinney, Hugh M. LATOX Department	X		1924
Stober, Ralph Chief Efficiency Engineer	XV	B.S.	1927
Taber, Wentworth D. Efficiency Engineer	XV-2	B.S.	1928
Wells, Edward J. Manufacturing Superintendent	III		1925

it that, though the individual is quite easily recognized, some of the characteristics are changed. Consequently we say that certain individuals take bad pictures and others take good pictures.

When three-dimensional movies are common, as they unquestionably will be, many a photogenic beauty may find herself three-dimensionally not so acceptable and vice versa. Directors will find that Miss X photographs better with decreased depth while Miss Y is greatly improved by an exaggerated depth. Amateur stereoscopic photographers can certainly perform a very valuable service in this totally unexplored field.

The more extensive fields of projecting stereoscopic pictures and of taking stereoscopic movies cannot be discussed here. I can say, however, that the possibilities are sometimes incredible. I have a few Kodachrome stereographs and a stereoscopic projector using polaroid lens caps. With these the image of an individual in full color can be so projected that it stands out in front of the screen. It is possible to put your arm around this image and receive a very curious feeling of surprise to find only empty space.

Enough has been said to indicate in a small way the fascination of three-dimensional photography. A real photographic enthusiast should not ignore a vast and rapidly developing branch of his hobby that offers more unsolved problems and more opportunities for ingenuity and imagination than any other.

"Thank you, Julius"

One thing we learned from Caesar that has stuck in our mind. It begins, "All Gaul is divided in three parts . . ." and it gave us an idea. *Our* policy is divided in three parts. You'll find they're worth remembering: QUALITY, SERVICE, ECONOMY.

Just words until you get them under a microscope and discover that Quality with us means guaranteed merchandise—products of all the leading manufacturers in the radio and camera fields. Service includes complete stocks of parts and equipment. Economy—bed-rock prices . . . substantial savings on everything you buy.

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L&B SONS

FARE, PLEASE

(*Continued from page 32*)

and control have been developed capable of a maximum acceleration of 4.75 mphps and an average rate of 4 mphps. A maximum speed of 50 mph is provided. In order to secure this rapid acceleration without discomfort to passengers, a commutator type control is used with a total of 260 resistance steps. The main power circuits are made and broken on a line breaker and a line contactor. The motor fields are shunted in two steps to give additional running speeds.

To secure braking adequate for this equipment three types of brakes are used: dynamic, magnetic track, and air. The first two slow the car down quickly and smoothly, and the air brake completes the stop and holds the car at rest. These rates exceed any previously used in practice and are comparable to those attained with the modern automobile. Service braking gives a retardation of 4.75 mphps and maximum rates as high as 9 mphps can be reached.

The Trolley Coach

Since about 1928 when the first of the modern trolley coaches went into service, there has been a steady increase in the number of these vehicles. While the earlier designs used two motors with series-parallel control, a single motor with rheostatic control is also being extensively used. These vehicles weigh from eight to ten tons and seat 30 to 45 passengers.

During the last two years operating studies have been made to determine the desirability of the compound-wound motor for trolley coach operation in order to take full advantage of electric braking.

This type of equipment has been successfully used in England for some time and is now in use in Columbus, Ohio and Baltimore, Md. The compound-wound motor characteristics are ideal for the utilization of electric braking, and furthermore permit a substantial reduction in rheostatic losses. The operator with this equipment can follow variations of traffic speed without removing his foot from the accelerating pedal. This regenerative braking is also particularly valuable for controlling the vehicle speed on hills. In normal operation dynamic electric braking, by feeding the generated current into a closed resistance, is used up to about 20 mph and regenerated back to the trolley at higher speeds. It is estimated that this use of the motor for electric braking may extend the life of friction brakes as much as 600 per cent.

The "All-Service Vehicle," used principally by the Public Service Co-ordinated Transport of Newark, N. J., is a combination of the features of the trolley coach with those of the gas-electric bus. Operation is thus permitted from the overhead power system where available, and on other routes as a self-propelled vehicle.

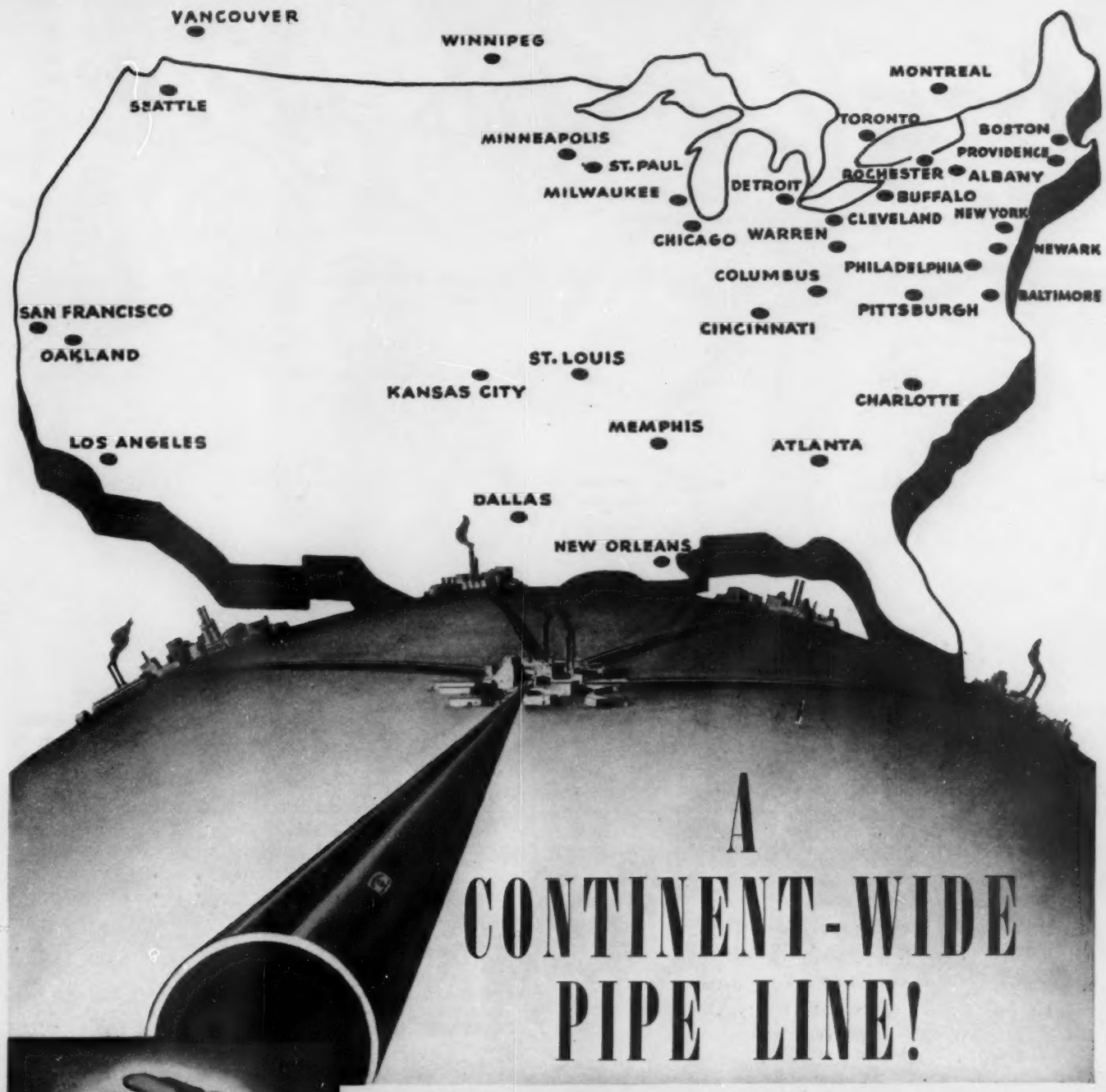
Diesel-Electric Bus

Electric drive, or an electric transmission between engine and driving wheels, admittedly is an essential factor in the successful use of the Diesel engine for urban bus operation. Flexible control at all bus speeds and the maintenance of a fairly constant economical speed of the Diesel engine insure easy handling and low maintenance. Added to these factors is the lower cost of Diesel fuel and its greater mileage per gallon. During the past two years nearly 250 of these Diesel-electric buses have been placed in service.

Rapid Transit

The five-section articulated cars placed in service by the Brooklyn Rapid Transit Corporation, Brooklyn, N. Y., during the last two or three years have made use of some of the same high acceleration and braking characteristics used in the Presidents' Conference Committee cars. Both dynamic and eddy-current brakes are in use in combination with magnetic track and air brakes. These features permit high schedule speeds in frequent stop service.

The 88 two-body articulated units placed in service over the new Bay Bridge at San Francisco, Calif., by the Key System will each seat 126 passengers and will operate in trains of three or more units.



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There Is A Grinnell Office As Near As Your Telephone

To the architect, engineer or contractor planning the installation of fire protection, piping, heating or humidification, prompt and helpful service from a nearby Grinnell office means a lot.

But the scope of Grinnell service is important in more than planning alone. It is a *complete* piping service, including automatic sprinkler fire protection, prefabricated piping, welding fittings, pipe hangers, Thermolier Unit Heaters, and Amco Humidification. To the owner of Grinnell equipment, it means prompt attention to routine or emergency demands.

That is why "The Industry Built on Piping" maintains seven strategically-located plants, thirteen branch warehouses and thirty-four sales offices. Specify Grinnell *whenever piping is involved.* Grinnell Company, Inc., Executive Offices, Providence, R. I., Branch offices in principal cities of the United States and Canada.

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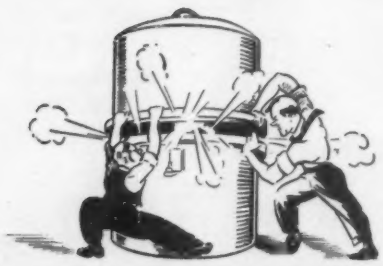
General Fire Extinguisher Company • *Columbia Malleable Castings Corporation* • *The Ontario Malleable Iron Company, Ltd.*

G-E Campus News



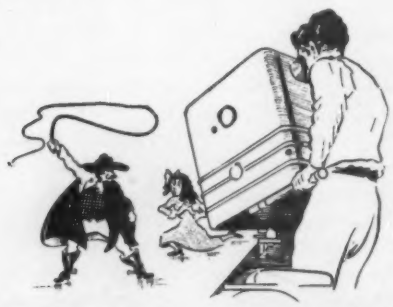
A BIG SQUEEZE

IT TAKES a lot of squeeze to put a 1,000,000-volt x-ray equipment in a container only four feet in diameter and seven feet long, especially when its less-powerful predecessors required a special building 62 feet long, 32 feet wide, and 36 feet high. But recently, G-E scientists applied the necessary squeeze and completed some surprisingly compact x-ray equipment.

Such squeezing naturally involves a few innovations in design. So innovations were introduced. The 11-section x-ray tube was put inside the novel transformer, in the space normally taken by an iron core. Gas having an impressive-sounding name, dichlorodifluoromethane, was used instead of oil as an insulating medium, 100 pounds of this gas doing the work of six tons of conventional oil.

Then the equipment was mounted in the grounded metal container, thereby enclosing the 1,000,000-volt circuit and eliminating the hazard of electric shock. Looking at the apparatus, you note a striking absence of moving parts, for the control of the apparatus is essentially electrical.

The first of the new units will be installed this spring in Memorial Hospital, New York City, providing medical science with another powerful weapon in its constant war on disease.



LIGHTS! ACTION! CAMERA!

IN A specially constructed room alongside the studios of the G-E international short-wave stations, the familiar words, "Lights! Action! Camera!" will soon be heard. For General Electric's new television station at Schenectady is nearing completion.

The television transmitter, perched atop the Helderberg Hills 12 miles outside the city, will be at least 250 feet higher than the station in the tower of the Empire State building, New York. And, broadcasting with 10,000 watts, it will be the most powerful television station in the United States.

There will be—literally—no strings to the transmitter. C. A. Priest, Maine '22 and an ex-Test man, Engineer of the Radio Transmitter Engineering Department of General Electric, has announced that an ultra-short-wave transmitter will be used instead of the usual cable to relay the images from the Schenectady studios to the main transmitter in the Helderbergs.

THE "HOUSE OF MAGIC" BECOMES TWINS

THE world-famous G-E "House of Magic" show has become twins. It had to, for it was placed in the predicament of having to be in two places at one time – the New York and the San Francisco Fairs.

One twin—directed by R. L. Smallman, Calif. Tech '33 and ex-Test man—is already holding court on San Francisco's Treasure Island, site of the Pageant of the Pacific. The other makes its bow April 30, opening day of the New York World's Fair. Its director is W. A. Gluesing, Wisconsin '23, also an ex-Test man.

The thousands of visitors to these Fairs will see such feats of modern magic as a voice-controlled toy train, a magic carpet, zigzagging pictures of sound. They will see the stroboscope, which makes it possible to see the spokes of a whirling wheel just as if the wheel were motionless. They will see a light beam sawed by the teeth of a comb.

However, entertaining as these demonstrations are, they represent far more than mere tricks of modern magic. They symbolize the work in pure science that is constantly taking place in G-E research laboratories—work which is the basis of General Electric's contributions to the world of the future.

GENERAL ELECTRIC

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